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Development of the Personnel-Based System Evaluation Aid (PER-SEVAL) Performance Shaping Functions

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This report describes how the Personnel-Based System Evaluation Aid (PER-SEVAL) performance shaping functions were developed. It describes how PER-SEVAL will use these functions to identify minimum levels of personnel characteristics for a particular contractor's design. Finally, procedures for future validation of the functions are outlined.

The PER-SEVAL performance shaping functions were developed by conducting regression analyses of data obtained from the U.S. Army Research Institute for the Behavioral and Social Sciences' Project A database. They predict task performance as a function of personnel characteristics and training. Separate functions are provided for different types of tasks. Two types of training variables are used in the performance shaping functions--frequency and recency of practice.

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FOREWORD

This report describes how the Personnel-Based System Evaluation Aid (PER-SEVAL) performance shaping functions were developed. PER-SEVAL is one of six automated aids being developed under the HARDMAN III development program. The objective of PER-SEVAL is to find values for the personnel characteristics that will meet system performance requirements given fixed values for conditions, training, and design. In essence, PER-SEVAL estimates the personnel quality requirements of a particular contractor's design.

Other automated tools in the HARDMAN III contract will assist U.S. Army personnel in developing system performance requirements; identifying manpower, personnel, and training constraints; determining maintenance manpower requirements; and assessing operator workload. HARDMAN III is one of several automated tools being developed for Army analysts by the U.S. Army Research Institute for the Behavioral and Social Sciences MANPRINT Division.

DEVELOPMENT OF THE PERSONNEL-BASED SYSTEM EVALUATION AID (PER-SEVAL) PERFORMANCE SHAPING FUNCTIONS

EXECUTIVE SUMMARY

Requirement:

To ensure the personnel quality requirements of new weapon systems, quantitative methods for predicting the impact of personnel characteristics on soldier performance must be developed.

Procedure:

Researchers conducted regression analyses on selected data from the U.S. Army Research Institute for the Behavioral and Social Sciences Project A data base. Separate analyses were conducted for different types of tasks. In each analysis, an attempt was made to predict performance as a function of the Armed Forces Vocational Aptitude Battery (ASVAB) composite and the frequency and amount of sustainment training.

Findings:

Performance shaping functions were developed for most of the task types. It was impossible to develop functions for several types of tasks because there were so few instances of these tasks in the Project A data base.

Utilization of Findings:

The performance shaping functions will be incorporated into the Personnel-Based System Evaluation Aid (PER-SEVAL). PER-SEVAL will assist Army analysts in assessing the personnel quality requirements of future Army systems. The functions could also be used in other tools required to predict task performance as a function of aptitude and sustainment training. The authors recommend that the performance shaping functions be validated in future ARI studies.

DEVELOPMENT OF THE PERSONNEL-BASED SYSTEM EVALUATION AID (PER-SEVAL) PERFORMANCE SHAPING FUNCTIONS

CONTENTS

LIST OF TABLES

CONTENTS (Continued)

CONTENTS (Continued)

LIST OF FIGURES

DEVELOPMENT OF THE PERSONNEL-BASED SYSTEM EVALUATION AID (PER-SEVAL) PERFORMANCE SHAPING FUNCTIONS

Introduction

Objective of Paper

This paper has two objectives. First, it describes how the Personnel-Based System Evaluation Aid (PER-SEVAL) performance shaping functions were developed. Second, it describes how these functions will be used to identify minimum levels of personnel characteristics for a particular contractor's design.

The paper builds on two earlier reports: the PER-SEVAL concept paper, which was delivered to ARI in April 1987, and the PER-SEVAL design specifications, which were delivered to ARI in December 1987.

Overview of PER-SEVAL

PER-SEVAL is one of six automated aids being developed under the MANPRINT methods contract. Figure 1 outlines the objective of PER-SEVAL. Performance is a function of personnel characteristics, conditions, training and the system design (and many other things as well, but these are the variables addressed by PER-SEVAL). The objective of PER-SEVAL is to find values for the personnel characteristics that will meet system performance requirements given fixed values for conditions, training, and design. In essence, what PER-SEVAL does is to estimate the personnel quality requirements of a particular contractor's design.

Performance = F (P,C,T,D)

P = Personnel Characteristics
C = Conditions
T = Training
D = Design

Objective: Find Values for "P" that Meet Performance Requirements Given Fixed Values of C, T, D.

Figure 1. Objective of PER-SEVAL.

The personnel quality requirements produced by the PER-SEVAL Aid will be part of the overall evaluation of a contractor's design. Evaluations may be made as early as the proof-of-principle phase of the acquisition process and would probably be continued in subsequent phases. The primary users of the

PER-SEVAL Aid would be the Directorate of Combat Developments personnel who provide input to the Cost and Operational Effectiveness Analysis (COEA) and the Logistic Support Analysis (LSA); and the logistics division of the program manager's staff who develop manpower and personnel information for the LSA.

The PER-SEVAL Aid receives critical inputs from three other MANPRINT methods aids--The System Performance and RAM Criteria Aid, The Personnel Constraints Aid, and The Manpower-Based System Evaluation Aid. The System Performance and RAM Criteria Aid (SPARC) produces estimates of system performance requirements. The Manpower-Based System Evaluation Aid (MAN-SEVAL) identifies the jobs and tasks associated with each contractor's design. The Personnel Constraints Aid (P-CON) describes the projected distribution of each personnel characteristic.

The PER-SEVAL Aid has three basic components. First, the PER-SEVAL Aid has a set of performance shaping functions that predict performance as a function of personnel characteristics and training. Second, the PER-SEVAL Aid has a set of stressor degradation algorithms that degrade performance to reflect the presence of critical environmental stressors. Third, the PER-SEVAL Aid has a set of operator and maintainer models that aggregate the performance estimates of individual tasks and produce estimates of system performance.

Figure 2 provides an overview of the procedures a user would employ in using PER-SEVAL. The user begins an application of the PER-SEVAL Aid by applying the performance shaping functions using the mean level of the personnel characteristics and the estimated amount of training for the new system. These performance estimates are then input into the stressor degradation algorithms where performance is degraded to reflect the presence of the stressors. Next, the revised task performance estimates are input into the operator and maintainer models which aggregate them to produce estimates of system performance. Then, required performance is compared with estimated performance at either the task or system level (the user selects the level). If performance is adequate, the PER-SEVAL Aid stops. Otherwise, the personnel characteristics are incremented or decreased and the entire process is iterated until required performance levels are met.

Overview of Performance Shaping Functions

PER-SEVAL performance shaping functions predict task performance as a function of personnel characteristics and training. Separate functions are provided for different types of tasks. Two types of training variables are used in the

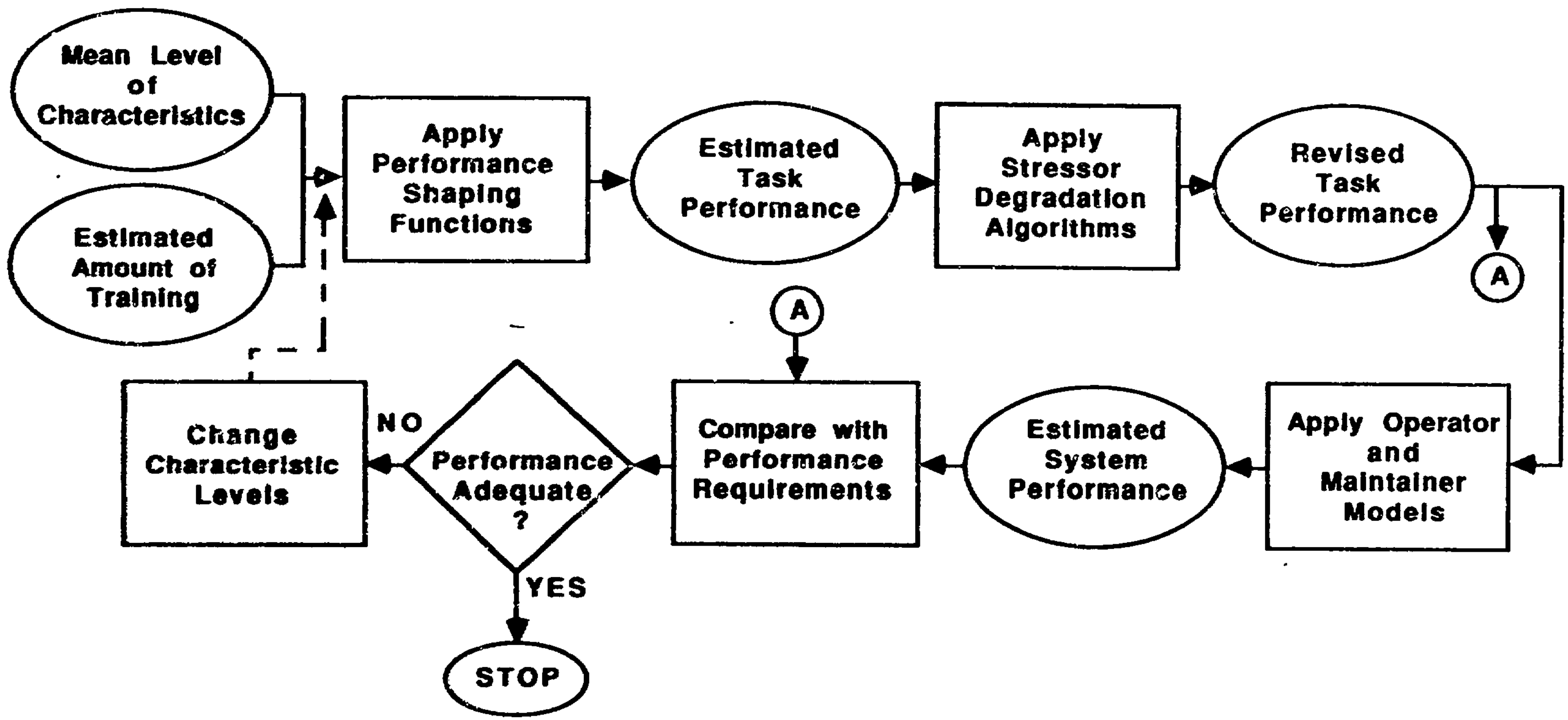


Figure 2. Overview of PER-SEVAL aid logic.

performance shaping functions -- frequency and recency of practice. The primary data source for the development of the performance shaping functions was the Project A data base.

Definition of personnel characteristics.

The performance shaping functions (PSFs) attempt to predict performance for "stable design-related" characteristics. These characteristics are defined as follows:

> A design-related personnel characteristic is an enduring human attribute that has a significant impact on operator or maintainer performance and has information available to estimate its current distribution within the Army.

One of the ultimate objectives of ARI MANPRINT tool development efforts is to allow Army users to compare the number of people required at or above a particular personnel characteristic level with the number available at or above this level (the latter is produced by P-CON). This type of comparison is only meaningful for stable or enduring personnel characteristics. For the same reason, a personnel characteristic must either have data available to describe its distribution within each Army MOS or we must be able to identify other existing data that can be reasonably generalized to Army MOSs. If we cannot describe a characteristic's distribution, we have no basis for describing its availability and no basis for setting a constraint in P-CON.

To be a design-related personnel characteristic, a characteristic must be related to operator and maintainer performance--namely, task performance time and/or accuracy. If a characteristic is not related to task time or accuracy, there is little a contractor can do to design a system to accommodate a given characteristic level. Four general types of characteristics meet the criteria described above -- cognitive, perceptual, psychomotor, and physical characteristics.

Of these four types of variables, the first three types (cognitive, perceptual and psychomotor) impact how well a task will be performed while the last type of characteristic (physical characteristics) primarily determine if a task can be performed. Since the focus of PER-SEVAL is on predicting how well a given population can perform a task, the PER-SEVAL PSFs focus on tasks falling into the first three categories.

Page 17 lists the specific characteristics included in the PER-SEVAL PSFs.

Training variables in performance shaping functions.

Originally, we intended to use "amount of initial training" as the training variable in our performance shaping functions. However, two problems with this variable were identified. First, there was a lack of data or data bases which could be used to relate this variable to task performance. Second, and perhaps most importantly, to use this variable we would have had to assume that all soldiers had just graduated from initial training since development of models to predict the impact of intervening variables on learning retention, task practice, and subsequent task performance would be very complex.

Because of these problems, it appeared that we would have to leave training completely out of our models. However, we were able to identify two training-related variables in the Project A data base. This data described how frequently and recently within the last six months a soldier had performed a task prior to the hands-on test. Together these two variables can be viewed as describing the amount and recency of practice given to a particular task. Since practice is one of, if not the key, training variable, we decided to use these variables as measures of the amount of sustainment or on-the-job training. Admittedly, these variables capture only a small part of the total system-specific training provided to Army soldiers. However, these are the only variables on which data was available.

Through some simple assumptions and algorithms, we were able to develop an approach for converting estimates of frequency of performance on the job into the Project A frequency and recency metrics. This allowed us to use an input variable (frequency of performance on the job) that will be more meaningful to PER-SEVAL users.

Overview of form of PSFs.

In our concept of the PER-SEVAL, performance shaping functions will be used to predict the performance level that can be expected for a given set of personnel characteristic levels and amount of training. The PER-SEVAL performance shaping functions will actually predict a relative change from a baseline value rather than absolute performance. Also note that the performance shaping functions will describe generic predictor-performance relationships for types of tasks rather than for specific tasks.

Table 1 displays the general form of the PER-SEVAL performance shaping functions. Note that the functions predict a Z score. The PER-SEVAL program will convert the Z score into the raw score using a standard algorithm for converting Z scores to raw scores. However, for the mean score, the program will use the user's estimate of the expected accuracy level for each task

Table 1

General Form of Performance Shaping Functions*

$$Z = \text{Personnel Characteristics} + \text{Practice}$$

$$BP_1 + BP_2 + BP_3 + BP_4 + \ldots BP_\rho$$

P_ρ = ρth Personnel Characteristic

BF + BR	B (R * F)

F = Frequency of Task Performance

R = Recency of Task Performance

Z = Predicted Z Score for Task Performance Measure

B = Standardized Regression Weights

associated with the specific contractor's design. (The time estimates produced by MAN-SEVAL are also based on these same assumptions.) This approach allows us to use a generic predictionequation associated with different types of tasks to predict performance on a particular task associated with a specific contractor's design. The mean estimate provided by the user captures the unique design features associated with a particular task. Thus, we assume that the hardware/software design determines the overall or mean level of performance of a task and that personnel characteristics or abilities determine scores of individual soldiers about this mean. This approach requires certain assumptions -- some statistical and some conceptual. These assumptions are described in detail on page 79.

Mechanisms for generalizing application of the PSFs to new tasks.

Development of the PER-SEVAL performance shaping functions is different than the typical regression analyses conducted in academic psychology because we are attempting to develop functions that can predict performance for a general class of tasks rather than a particular task. Our ultimate goal is to predict performance for the tasks associated with new weapon systems. Two assumptions or mechanisms allow us to make generalized predictions for new tasks. First, we assume that the generalized relationships we develop for a particular taxon apply to all tasks which fall into that taxon. (On page 87, we outline a set of procedures for validating this assumption). Second, we use the functions to predict Z scores -- that is deviation from a mean value which is tied to specific task's overall task difficulty within a hardware/software design. These two assumptions permit us to develop functions which are scale invariant -- that is, the functions predict performance for any task in that taxon no matter what its scale. This allows us to generalize beyond the specific types of scales (e.g., per cent correct) which were used during PSF development.

History of the performance shaping function concept.

Our concept of performance shaping functions is derived from past work on human reliability analysis. Swain (1967) introduced the term "performance shaping factor" to describe the external and internal factors which modify or influence human performance. Since that time, performance shaping factors have been identified and applied in a wide range of human reliability analyses. A description of performance shaping factors and their use in human reliability analysis is provided in Miller and Swain (1986), and Meister (1985). Performance shaping factors have included "external" variables such as work space layout, environmental conditions, and human engineering design, and internal variables

such as training/experience, skill level, intelligence, perceptual abilities, and physical condition (Miller and Swain, 1987). In a typical human reliability analysis using these factors, task accuracy estimates are first adjusted to account for the impact of the performance shaping factors and these adjusted estimates are combined in a reliability model to produce overall reliability estimates. The impacts of the performance shaping factors on performance are typically expressed as a percentage change from a baseline. Table 2 displays some percentage values that Swain and Guttman (1983) developed to describe the impact of stress on task accuracy for novice and skilled workers.

Data on the impacts of performance shaping factors may be derived from empirical studies or from the application of expert judgment techniques. Miller and Swain (1987) provide a description of recent developments in the application of expert judgment techniques.

Although not labelled as "performance shaping factors" per se, the concept of human performance shaping factors has been used in other areas as well. Human engineering design handbooks often use the performance shaping function approach (percentage impact on a baseline for different types of tasks) to provide guidance for assessing the impact of environmental conditions or other related variables on human performance. For example, Figure 3 lists guidance for assessing the impact of wet bulb temperature on performance for different types of tasks taken from the Handbook of Perception and Human Performance, Boff, Kaufman, & Thomas, 1986.

Constraints on Development of Performance Shaping Functions

Resource and time constraints had a significant impact on the development of the PER-SEVAL performance shaping functions. The general philosophy of the MANPRINT methods contract was to develop automated MANPRINT aids using state-of-the-art technology and existing data. The PER-SEVAL development schedule reflected this philosophy. Consequently, there was neither time nor resources for

a) the collection of additional task performance data. Thus, we developed the functions using performance data available in existing data bases.

b) validation of performance shaping function development process. (Page 87 describes a plan for validation).

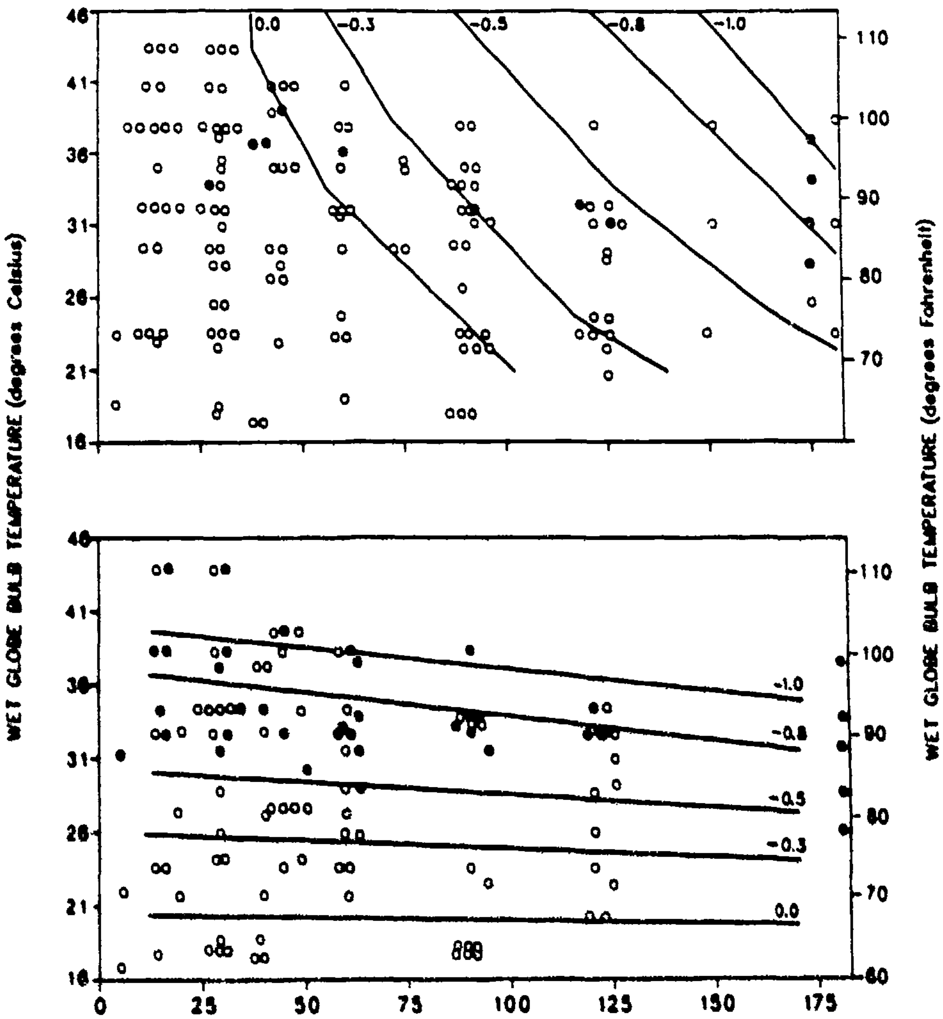
The goal of the PER-SEVAL performance shaping functions is an ambitious one--development of a generic set of functions for predicting performance as a function of personnel characteristics and training using existing data sources that can be applied

Table 2

Model Accounting for Stress and Experience in Performing Routine Tasks*

	% Increase in Error Probability	
Stress Level	Skilled	Novice
Very Low	200	200
Optimum	100	100
Moderately High	200	400
Extremely High	500	100

*Derived from Swain, A.D., and Guttmann, H.E. (1983, August). Handbook of human reliability and analysis with emphasis on nuclear power plant application (Sandia National Laboratories, NUREG/CR-1278). Washington, DC: U.S. Nuclear Regulatory Commission.



* *From J.D. Ramsey & S.J. Morrissey. Isodecrement curves for task performance in hot environments. Applied Ergonomics, 9. Copyright 1978 by Butterworth Scientific Ltd., Guildford, Surrey, UK. Reprinted with permission.*

Figure 3. Example of the "performance shaping function."

across tasks and MOSs. We believe we have constructed a set of functions that can accomplish this goal and can be incorporated into an automated aid that can be used by Army users to assess personnel quality requirements. However, we recognize that there is much additional work that can and should be done to improve these functions (page 87 describes some of this additional work). Our philosophy has been that it is better to give users a slightly imperfect tool that can help them in the near term rather than to tell them to wait while the "perfect tool" is developed.

Overview of Data Sources for Development of Performance Shaping Functions

The primary data source for the development of the Performance Shaping Functions was ARI's Manpower and Personnel Research Division (MPRD) Project A data base. Project A is more formally known as the project for "Improving the Selection, Classification, and Utilization of Army Enlisted Personnel." To date, Project A is the only data base we have been able to identify that contained the data needed to develop the performance shaping functions. More specifically, the Project A data base has hands-on performance data, personnel characteristics, and training data for nine Army MOS:

11B Infantryman
13B Cannon Crewman
19E Armor Crewman
31C Single Channel Radio Operator
63B Light Wheel Vehicle Mechanic
64C Motor Transport Operator
71L Administrative Specialist
91A Medical Specialist
95B Military Police

The hands-on performance data includes both accuracy and time data. To facilitate aggregation across tasks, the hands-on accuracy measure used on almost all the Project A tasks was " % steps correct." While this measure met the needs of the Project A study, it is, admittedly, not the ideal performance measure for developing PSFs for predicting weapon system task performance for certain types of tasks. (Page 87 describes alternative measures for achieving this objective.) However, since it was the predominant type of accuracy measure in the Project A data base, we had to use it. Still, no matter what measure was used, we had the problem of generalizing to other measures or scales (see page 7).

The Project A data base contained time data on many but not all of the hands-on tasks. Appendix A lists, by MOS, all of the hands-on tasks contained in the Project A data base and their mean accuracy and time measures.

The Project A data also contained personnel characteristic scores for each individual in the data base. Table 3 summarizes the personnel characteristic measures that are included in the Project A data base. Note that the Project A data contained values on seven new predictors developed during the initial stages of Project A. These seven new predictors are actually composites of several subtests (see Table 4). The ASVAB area scores are also composites of several subtests (see Table 4).

The Project A data base also had data on the frequency and recency with which the hands-on tasks were performed. Table 5 lists the scales that were used to assess these measures.

In addition to the Project A data base, the other data source used for performance shaping functions were recent review articles (Genaidy, Asfour, and Tritar, 1988; and Genaidy and Asfour, 1987) on models that predict performance on manual handling tasks. Selected regression models from these articles will be used to predict performance for gross motor tasks.

Because we are using the manual handling regression models "as is" and not developing them "from scratch," there is no discussion of these models in the description of the development of performance shaping functions which follows. These models were described in the "PER-SEVAL Design Specifications" submitted to ARI in December 1987.

Table 3

Key Personnel Characteristics in Project A Data Base

TYPE		VARIABLE	MEAN	STD DEV	MINIMUM	MAXIMUM	N
Cognitive	• ASVAB Area Composites						
	SC = Surveillance Communication	A1AC80SC	106.06	13.50	67	139	5187
	CO = Combat	A1AC80CO	106.85	12.78	72	145	5187
	FA = Field Artillery	A1AC80FA	104.51	12.53	66	144	5187
	OF = Operators and Food	A1AC80OF	106.28	11.74	71	137	5187
	ST = Skilled Technical	A1AC80ST	103.12	13.66	65	139	5187
	GT = General Technical	A1AC80GT	103.58	12.63	72	130	5187
	GM = General Maintenance	A1AC80GM	104.43	13.95	60	144	5187
	EL = Electronics	A1AC80EL	103.50	13.21	68	141	5187
	CL = Clerical	A1AC80CL	102.89	12.82	73	134	5187
	MM = Mechanical Maintenance	A1AC80MM	106.84	12.51	68	142	5187
	• Numerical Speed and Accuracy*	B3CCNMSA	-98.28	28.40	-318	-38	5067
	• Reading Grade Level	RGRLVL	9.79	1.56	6.20	12.90	5187
	• Spatial*	B3PCSPAT	302.77	43.35	145	401	5193
Perceptual	• Complex Perceptual Accuracy*	B3CCCPAC	150.82	21.18	30	192	5145
	• Complex Perceptual Speed*	B3CCCPSP	-48.95	22.89	-175	23	5145
Psychomotor	• Psychomotor*	B3CCPSYM	-198.09	38.30	-388	-100	5145
	• Simple Reaction Speed*	B3CCSRSP	.57	15.79	-248	26	5155
	• Simple Reaction Accuracy*	B3CCSRAC	100.68	14.38	-25	108	5155

* New Project A Predictor

Table 4

Subtests in New Project A Personnel Characteristics Composites and ASVAB Area Composites

COMPOSITE SCORE	SUBTESTS	ADDITIONAL DESCRIPTION
I. New Project A Personnel Characteristics		
Numerical Speed and Accuracy (B3CCNMSA)	Number Memory Test Number Memory Test Number Memory Test Number Memory Test	Mean for Final Response (Final Decision Time) Mean Hit Rate (Initial Decision Time) Pooled Mean Operation Time (Mean Decision Time) Mean for Initial Input (Percent Correct)
Overall Spatial (B3PCSPAT)	Assembling Objects Test Map Test Maze Test Object Rotation Test Orientation Test Figural Reasoning Test	None None None None None None
Complex Perceptual Accuracy (B3CCCPAC)	Perceptual Speed and Accuracy Test Target Identification Test Short Term Memory Test	Mean Hit Rate (Percent Correct) Mean Hit Rate (Percent Correct) Mean Hit Rate (Percent Correct)
Complex Perceptual Speed (B3CCCPSP)	Perceptual Speed and Accuracy Test Target Identification Test Short-Term Memory Test	Mean of Trimmed Decision Time Mean of Trimmed Decision Time Mean of Trimmed Decision Time
Psychomotor (B3CCPSYM)	Cannon Shoot Test Target Shoot Test Target Shoot Test Target Tracking 1 Target Tracking 2 Pooled Mean Movement Time	Mean Abs. Time Discrep Mean Log (Dist + 1) Mean Time to Fire Mean Log (Dist + 1) Mean Log (Dist + 1) None
Simple Reaction Accuracy (B3CCSRAC)	Choice Reaction Simple Reaction	Mean Percent Correct Mean Percent Correct
Simple Reaction Speed (B3CCSRSP)	Choice Reaction Time Simple Reaction Time	Mean of Trimmed Choice Decision Time Mean of Trimmed Choice Decision Time

Table 4

Subtests in New Project A Personnel Characteristics Composites and ASVAB Area Composites (Cont.)

COMPOSITE SCORE	SUBTESTS	ADDITIONAL DESCRIPTION
II. ASVAB Area Composites		
Clerical (CL)	AR MK VE[1]	Arithmetic Reasoning ASVAB Subtest - AR Math Knowledge ASVAB Subtest - MK Verbal Equivalent ASVAB Subtest - VE[1]
Combat (CO)	AR AS MC CS	 Auto & Shop Information ASVAB Subtest - AS Mechanical Comprehension ASVAB Subtest - MC
Electronics Repair (EL)	AR EI MK GS	 Electronics Information ASVAB Subtest - EI General Science ASVAB Subtest - GS
Field Artillery (FA)	AR MK MC CS	 Coding Speed ASVAB Subtest - CS
General Maintenance (GM)	MK EI GS AS	
General Technical (GT)	VE AR	
Mechanical Maintenance (MM)	NO EI MC AS	Numerical Operations ASVAB Subtest - NO
Operators and Food (OF)	NO VE MC AS	
Surveillance and Communication (SC)	AR AS MC VE	
Skilled Technical (ST)	VE MK MC GS	

[1] The Verbal Equivalent ASVAB Subtest (VE) is formed by combining scores from the Paragraph Comprehension (PC) and Word Knowledge (WK) ASVAB subtests.

Table 5

Project A Task Frequency and Recency Scales

FREQUENCY
•• Not at All
•• 1-2 Times (per Six Months)
•• 3-5 Times (per Six Months)
•• 6-10 Times (per Six Months)
•• More than 10 Times (per Six Months)
RECENCY
•• During Past Month
•• 1-3 Months Ago
•• 4-6 Months Ago
•• More than Six Months Ago
•• Never

Preparation of Data for Entry into Regression Analyses

Selection of Personnel Characteristics

Seven factors were considered in selecting the personnel characteristics to be included in the PSFs:

(1) The personnel characteristic had to be included in the Project A data base

(2) The characteristic had to be a stable design-related characteristic as defined on page 4.

(3) The characteristic had to have sufficient variability to be used as a predictor. Some of the characteristics we had initially hoped to include (i.e., the PULHES scores) did not have such variability. For example, on some of the PULHES scores, more than 95% of the Project A population had the same score.

(4) Most of the Project A population had to have scores on the characteristic. For instance, we originally hoped to include MEPSCAT as a characteristic. But only one fifth of the Project A population had scores on this variable. Because this one fifth was spread across the different types of tasks, there was an insufficient sample to use this characteristic.

(5) A characteristic was excluded if it was incorporated into a higher level measure. (For example, all of the new predictors in the Project A data base were combined into seven composite scores). This approach was taken to: (a) minimize the number of characteristics included in the PSFs, and (b) to improve the reliability of the characteristics (the data suggested that the aggregate measures are more reliable than the lower level measures).

(6) A characteristic was excluded if it was expected that it would only be related to performance on gross motor-heavy tasks since predictions for these tasks would be handled by the material handling models (see page 11). Three physical characteristics were excluded for this reason--height, weight, and diastolic blood pressure.

(7) The only ASVAB measures which were included were the ASVAB area composites and the reading grade level derived from the GT composite using conversion algorithms described in Grafton (in press). Other ASVAB measures which were available (e.g., ASVAB Quantitative and ASVAB Verbal) were excluded because of their redundancy with the ASVAB area

composite scores. The area composites are the measures used to control entry into MOSs. Reading grade level was included, despite its near perfect correlation with the GT composite, because of its possible contribution to the prediction of performance in MOSs which did not use the GT composite as a selection tool.

Table 6 lists the final set of personnel characteristics that were included in the regression analyses used to develop the PSFs. The characteristics are divided into three groups--cognitive, perceptual, and psychomotor. Appendix B documents our rationale for excluding particular Project A characteristics.

Development of Task Taxonomy

The MPT² task taxonomy has two major uses. First, it was used to guide the development of the PSFs -- different functions were developed for the different taxons in the taxonomy. Second, it was used to guide the development of the stressor degradation algorithms -- different algorithms were developed for different types of tasks.

In developing the MPT² task taxonomy, we attempted to develop a classification scheme which would: (a) provide the minimum number of taxons needed to achieve the two objectives described above, and (2) classify tasks and not task elements. The first objective was important because we want to minimize user input requirements and PSF development costs. The latter objective was important because we want the PER-SEVAL models to be applicable at the task level. That is, we want users to be able to assign an individual task to one or more taxons without requiring them to identify specific elements constituting that task. In doing so, we can significantly reduce user input data requirements (users who want to apply the models at the task element level can do so). It should be noted that many behavioral classification schemes, such as Fleishman's (Fleishman and Quaintance's, 1984), are very detailed and are more applicable at the task element level.

The PER-SEVAL task taxonomy is primarily an expansion of Berliner's (1966) task taxonomy. However, an attempt was made to incorporate key features of Wicken's (1981) structure for processing resources. These two structures are reasonably congruent with one another. Task types were eliminated which, while possible to imagine on a theoretical basis, seldom occur in the Army (e.g., auditory pattern recognition/discrimination). Table 7 displays the PER-SEVAL task taxonomy. Some of the lower level taxons in the hierarchy (see the highlighted taxons in Table 7) are only used in the stressor degradation algorithms and are not used in the PSFs.

Table 6

Personnel Characteristics Used to Develop New PSFs

Type	
Cognitive	• ASVAB Area Composites SC = Surveillance Communications CO = Combat FA = Field Artillery OF = Operators and Food ST = Skilled Technical GT = General Technical GM = General Maintenance EL = Electronics CL = Clerical MM = Mechanical Maintenance • Numerical Speed and Accuracy* • Reading Grade Level • Spatial*
Perceptual	• Complex Perceptual Accuracy* • Complex Perceptual Speed*
Psychomotor	• Psychomotor* • Simple Reaction Speed* • Simple Reaction Accuracy*

* New Project A Predictor

Table 7

MPT² Task Taxonomy

Type	Taxon
Perceptual	• Visual Recognition/Discrimination
Cognitive	• Numerical Analysis • Information Processing/Problem Solving
Motor	• Fine Motor - Discrete • Fine Motor - Continuous • Gross Motor - Light • Gross Motor - Heavy - Lifting, Lowering* - Torquing/Pulling* - Carrying*
Communication	• Oral - Face to Face - Non-Face to Face • Reading and Writing

[shaded box] = this level of taxon only used in stressor degradation models

* These taxons used only in material handling models

Definitions and examples of each of the taxons are provided in Appendix C.

Linkage of Personnel Characteristics to Task Taxonomy Categories

Table 8 displays our estimates of the personnel characteristics that can be expected to predict performance for each of the taxons in the task taxonomy. ASVAB area composite is listed as a potential predictor for each taxon. Four of the new Project A predictors (complex perceptual accuracy, complex perceptual speed, simple reaction speed, and simple reaction accuracy) are also listed as potential predictors for every taxon. However, the two accuracy measures (complex perceptual accuracy, simple reaction accuracy) were used to predict task accuracy and the two speed measures (complex perceptual speed and simple reaction speed) were used to predict task time. The logic underlying these assignments was that these composites were complex and not easily assigned to a particular taxon. The remaining two Project A predictors (numerical speed and accuracy and psychomotor) could be readily tied to specific taxons. Numerical speed and accuracy is expected to be a predictor of the numerical taxon. Psychomotor is expected to be a predictor of the four psychomotor taxons. Reading grade level is expected to be a predictor of the communication - reading and writing taxon.

Assignment of Project A Tasks to Taxons

Using the definitions listed in Appendix C, DRC staff assigned each of the Project A hands-on tasks to one or more of the taxons. Each task could be assigned to a maximum of three taxons. We also estimated the expected percentage of task elements involving each taxon. This process paralleled the (expected) approach that users will take in assigning tasks to taxons in PER-SEVAL (see page 77 for a description of this process). The assignments and estimated percentages for each task are listed in Appendix A.

Table 9 displays the distribution of the hands-on tasks across taxons within each MOS based on the primary taxon assignment. Note that one of the taxons (gross motor-heavy) was not represented in the Project A data base. This does not pose a problem since we planned on using existing manual handling models for this type of task (see page 12). For several of the other taxons (e.g., visual recongnition/ discrimination, gross motor-light), there was a small number of tasks in the Project A data base. This posed a problem since we needed multiple tasks within the same taxon in an MOS to build a taxon performance measure. (Without such a measure, we cannot develop a PSF for that taxon.) To overcome this problem, we began to examine the knowledge test items in the Project A data base as a possible additional source of task items. We did this because we believed that for certain

Table 8

Personnel Characteristics Expected to be Predictors of Taxon Performance Measures

MPT2 TASK TAXONOMY	PERSONNEL CHARACTERISTICS: ASVAB Composite	Reading Grade Level	Complex Perceptual Speed*	Complex Perceptual Accuracy*	Overall Spatial*	Numerical Speed & Accuracy	Psychomotor*	Simple Reaction Speed*	Simple Reaction Accuracy*
1.1 Visual Recognition/Discrimination	X		T	A	X			T	A
2.1 Numerical Analysis	X		T	A	X	X		T	A
2.2 Information Processing/Problem Solving	X		T	A	X			T	A
3.1.1 Fine Motor - Discrete	X		T	A	X		X	T	A
3.1.2 Fine Motor - Continuous	X		T	A	X		X	T	A
3.2.1 Gross Motor - Heavy	Covered in Material Handling Models								
3.2.2 Gross Motor - Light	X		T	A	X		X	T	A
4.1 Communication - Reading and Writing	X	X	T	A	X			T	A
4.2 Communication - Oral	X		T	A	X			T	A

*This characteristic is unique to the Project A data
T = Predictor of TIME only
A = Predictor of ACCURACY only

Table 9

Distribution of Hands-On Tasks Across Taxons*

TAXON		11B	13B	19E	31C	63B	64C	71L	91A	95B	TOTAL
1.1	Perceptual - Visual Recognition/Discrimination	1 (.07)	0	0	0	0	1 (.06)	0	0	0	2
2.1	Cognitive - Numerical	1 (0.7)	13 (.18)	1 (.07)	1 (.07)	1 (.07)	2 (.13)	1 (.07)	1 (.06)	5 (.29)	26
2.2	Cognitive - Reason/PS/Dia.	0	0	0	4 (.27)	3 (.20)	0	0	0	1 (.06)	8
3.1.1	Fine Motor - Discrete	8 (.57)	14 (.82)	11	9 (.60)	10 (.67)	12 (.75)	10 (.71)	15 (.88)	10 (.59)	99
3.1.2	Fine Motor - Continuous	2 (.14)	0	0	0	0	1 (.06)	0	0	0	3
3.2.1	Gross Motor - Heavy	-	-	-	-	-	-	-	-	-	-
3.2.2	Gross Motor Light	2 (.14)	0	1 (.07)	0	0	0	0	0	0	3
4.1	Communication - Reading and Writing	0	0	0	0	0	0	3 (.21)	1 (.06)	0	4
4.2	Communication - Oral	0	0	2 (.13)	1 (.07)	1 (.07)	0	0	0	1 (.06)	5
	Total	14	17	15	15	15	16	14	17	17	140

* Numbers in parentheses refer to percentage of tasks falling into that taxon for each MOS.

taxons (e.g., communication-reading/writing) there was a great deal of similarity in the way that Project A hands-on and knowledge items were measured--that is, actual performance of the task tapped by the hands-on measures played a small role in overall task performance. Thus, we decided to include knowledge items for the four taxons without a significant psychomotor component, (i.e., visual recognition/discrimination, cognitive-numeric, cognitive-reasoning/problem solving/decision making, and communication reading/writing). Pages 26 to 36 describe the knowledge items included in each taxon.

Selection of Tasks For Taxon Measures

In order to predict performance, we selected a set of tasks to represent each taxon. Since we intended to construct taxon performance scores by aggregating across tasks falling into that taxon for a particular individual, all of the tasks selected for a particular taxon had to come from the same MOS. Two criteria were used to determine which MOS would represent a particular taxon. First, the MOS had to have a relatively large number of tasks falling into a particular taxon. It is important to stress the word "relatively" because for some taxons the maximum number of tasks within any MOS was only 2 or three. Second, where there were several MOSs to select from, we selected the MOS which (a) had available training frequency and recency and time data and (b) had a relatively large number of hands-on task items. The emphasis on the hands-on measures reflects our overall preference for the hands-on measures.

In selecting tasks to represent a taxon, we also examined the contribution of individual tasks to overall scale consistency (coefficient alpha). We used this examination as a statistical check on our taxon assignments. Assignments for tasks which were not consistent with the overall scale were reexamined. This was accomplished by reviewing the Project A descriptions. Based on this review, taxon assignments were changed for a few of the tasks. However, if the taxon assignment was deemed appropriate, it was left in the taxon measure despite its lack of statistical consistency with the overall measure. We used this procedure because we wanted to take a predominantly rational rather than a purely empirical approach to the construction of taxon scale measures.

Table 10 lists the MOSs selected to represent each taxon and the types of tasks included in each taxon measure. A more detailed description of the tasks selected for each taxon follows.

Visual recognition/discrimination.

Table 11 summarizes the tasks used to construct the performance measures for this taxon. Only two MOSs (11B and 64C)

Table 10

Summary of MOSs and Tasks Used to Construct Taxon Measures

Taxon	MOS to be Used	Number of Hands-On Tasks Used in Taxon Measure		Number of Knowledge Items Used in Taxon Measure		Total Number of Tasks Used in Taxon Measure	
		TIME	ACCURACY	TIME	ACCURACY	TIME	ACCURACY
Visual Recognition/ Discrimination	11B	-	1	-	1	-	2
Numerical Analysis	95B	5	5	-	-	5	5
Information Processing/Problem Solving	31C	4	5	-	3	4	5
Fine Motor - Discrete	95B	8	10	-	-	10	10
Fine Motor - Continuous		Insufficient data to develop PSFs					
Gross Motor - Heavy		Material handling models used					
Gross Motor - Light	11B	-	2	-	-	-	2
Communication - Reading and Writing	71L	3	3	4	7	7	10
Communication - Oral	19E	2	2	-	-	2	2

Table 11

Description of Tasks Used in Constructing Taxon Measure: Visual Recognition/Discrimination

TAXON 1.1 MOS 11B

PROJECT A TASK CODE	TASK TITLE	TYPE	ACCURACY			TIME 1			FREQUENCY			RECENCY			OTHER			
			MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	NAME	MEAN	S.D.	N
FHG9	Conduct Day and Night Surveillance Without Aid of Electronic Devices [Total Score (TS) Measure]	HoT	74.47	30.44	658	-	-	-	2.87	1.45	691	2.60	1.37	688	-	-	-	-
XKG3	M Armored Vehicles [PC task]	Know	67.36	19.60	691	-	-	-	-	-	-	-	-	-	-	-	-	-

NOTE: In the column labeled TYPE, "HoT" represents Hands-On-Tasks in the Project A Concurrent Validity Database, and "Know" represents knowledge or paper and pencil tasks.

had tasks in this taxon and each of these only had one task. The 11B task (Conduct Day and Night Surveillance Without the Aid of Electronic Devices) was especially interesting because rather than using "% steps correct," a measure of the % correct visual identifications was used. (The actual measure was targets correctly located in one minute plus total targets correctly located minus false detections). Consequently, we decided to use 11B as the source for developing this taxon. To supplement the one hands-on task for 11B, we decided to use one knowledge item for the task "Identify Armored Vehicles." In testing this item, soldiers were shown photographs of actual armored vehicles and asked to identify the vehicle from a set of choices.

Cognitive - numerical.

Table 12 summarizes the tasks used to construct the performance measures for this taxon. Only MOS 95B, had more than two tasks falling into this taxon --hence, 95B data was used to develop the cognitive-numerical taxon.

Table 12

Description of Tasks Used in Constructing Taxon Measure: Cognitive - Numerical Analysis

TAXON 2.1 MOS 95B

PROJECT A TASK CODE	TASK TITLE	TYPE	ACCURACY			TIME 1			FREQUENCY			RECENCY			OTHER			
			MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	NAME	MEAN	S.D.	N
BHQ8	Estimate Range	HoT	33.83	30.06	670	-	-	-	2.26	1.31	684	3.04	1.48	677	-	-	-	-
XHC1	Determine a Magnetic Azimuth Using a Compass	HoT	81.15	25.53	688	68.44	34.58	634	3.01	1.33	687	2.27	1.10	681	-	-	-	-
XHC2	Determine Grid Coordinates of a Point on a Military Map Using the Military Grid Reference System	HoT	84.98	16.41	674	65.82	162.87	689	3.25	1.28	685	1.96	0.99	680	Time 2	39.00	28.03	627
XHC6	Call For/Adjust Indirect Fire	HoT	19.68	18.73	656	57.69	44.71	436	1.62	0.66	686	3.79	1.20	673	Time 2	88.44	58.05	390
XHC7	Navigate from One Point on the Ground to Another Point	HoT	84.71	24.33	664	-	-	-	2.62	1.32	683	2.68	1.31	675	-	-	-	-

NOTE: In the column labeled TYPE, "HoT" represents Hands-On-Tasks in the Project & Concurrent Validity Database, and "Know" represents knowledge or paper and pencil tasks.

Cognitive - reasoning/problem solving/decision making.

Table 13 summarizes the tasks used to construct the performance measures for this taxon. MOS 31C had five hands-on tasks falling into this taxon and three tasks with clearly relevant knowledge measures, which were also used in the taxon measure.

Table 13

Description of Tasks Used in Constructing Taxon Measure: Cognitive - Information Processing/ Problem Solving

TAXON 2.2 MOS 31C

PROJECT A TASK CODE	TASK TITLE	TYPE	ACCURACY			TIME 1			FREQUENCY			RECENCY			OTHER			
			MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	NAME	MEAN	S.D.	N
GHH3	Perform Operator's Troubleshooting Procedures on Generator Set [PU-620]	HoT	80.25	25.47	343	-	-	-	3.19	1.55	346	2.21	1.43	347	-	-	-	-
GHI1	Op. Teletypewriter AN/GRC-142	HoT	76.86	16.27	336	315.27	211.94	313	3.06	1.58	356	2.41	1.49	358	-	-	-	-
GHJ1	Estab/Enter/Leave Radio Net [Includes Time Measure (T1)]	HoT	62.23	26.66	339	313.96	194.40	331	3.71	1.48	354	1.96	1.21	356	-	-	-	-
GHJ3	Use the KTC 1400 D Numerical Cipher/Authentication System	HoT	59.89	34.58	340	392.59	186.40	324	3.17	1.49	356	2.35	1.33	356	-	-	-	-
GHJ4	Prepare a Message in 16-Line Format	HoT	67.96	19.20	347	337.37	147.92	318	3.76	1.47	353	2.04	1.21	357	-	-	-	-
GKI2	Troubleshoot GRC-142 [PC Task]	Know	52.93	21.53	351	-	-	-	-	-	-	-	-	-	-	-	-	-
GKI6	Troubleshoot GRC-106 [PC Task]	Know	62.02	27.09	336	-	-	-	-	-	-	-	-	-	-	-	-	-
GKJ2	Operate in Radio Nets [PC Task]	Know	56.27	22.41	348	-	-	-	-	-	-	-	-	-	-	-	-	-

NOTE: In the column labeled TYPE, "HoT" represents Hands-On-Tasks in the Project A Concurrent Validity Database, and "Know" represents knowledge or paper and pencil tasks.

Fine motor - discrete.

Table 14 summarizes the tasks used to construct the performance measures for this taxon. Since most of the Project A hands-on measures fell into this taxon (this is not surprising since the % steps correct metric is most appropriate for this type of task), there were many MOSs to select from. We selected 95B because it had training frequency and recency data for each fine motor - discrete task and because it had time data available for the vast majority (eight out of ten) of these tasks.

Table 14

Description of Tasks Used in Constructing Taxon Measure: Fine Motor - Discrete

TAXON 3.1.1 MOS 95B

PROJECT A TASK CODE	TASK TITLE	TYPE	ACCURACY			TIME 1			FREQUENCY			RECENCY			OTHER			
			MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	NAME	MEAN	S.D.	N
BHE1	Prepare/Operate FM Radio Set	HoT	75.63	17.44	674	331.6	162.96	574	3.28	1.5	686	2.11	1.22	680	-	-	-	-
BHH1	Perform/Operator/Crew Preventive Maintenance Checks and Services	HoT	76.26	15.19	671	-	-	-	4.4	1.12	688	1.42	.09	684	-	-	-	-
BHL6	Use Hand and Arm Signals to Direct Traffic	HoT	81.82	22.72	676	-	-	-	3.59	1.47	687	1.99	1.18	683	-	-	-	-
XHA2	Perform Cardiopulmonary Resuscitation (CPR) on an Adult Using the One-Man Method	HoT	69.72	28.41	682	33.49	24.15	542	2.09	1.2	685	3.21	1.39	680	Time 2	182.84	282.27	540
XHA4	Put On-Field or Pressure Dressing	HoT	74.12	20.61	682	68.9	34.11	533	2.42	1.21	687	2.7	1.32	681	Time 2	48.47	35.03	504
XHB1	Operate and Maintain a .45 Caliber Pistol	HoT	87.25	10.66	623	11.89	9.7	621	4.36	1.13	688	1.45	0.86	684	Time 2	19.73	18.98	613
															Time 3	42.32	23.30	619
															Time 4	82.46	54.31	613
															Time 5	13.04	13.31	602
XHB2	Operate and Maintain a .38 Caliber Revolver	HoT	90.34	11.18	50	114.18	7:55	49	-	-	-	-	-	-	Time 2	12.64	15.66	50
XHB3	Load, Reduce a Stoppage, and Clear an M16A1 Rifle	HoT	84.27	14.19	682	12.21	8.16	680	3.36	1.4	688	2.11	1.13	682	-	-	-	-
XHB5	Load, Reduce a Stoppage and Clear M60 Machinegun	HoT	83.43	20.01	678	37.07	23.53	661	2.89	1.48	687	2.6	1.3	681	Time 2	25.59	16.30	627
															Time 3	29.88	26.47	659
XHD1	Put On, Wear, Remove M17 Protective Mask with Hood	HoT	85.6	17.29	661	8.72	2.56	651	3.62	1.29	686	1.83	0.91	682	Time 2	9.94	6.63	633

NOTE: In the column labeled TYPE, "HoT" represents Hands-On-Tasks in the Project A Concurrent Validity Database, and "Know" represents knowledge or paper and pencil tasks.

Fine motor - continuous.

There was only one task falling into this taxon in the entire Project A data base--Operate Tractor and Semitrailer from MOS 64C. Additionally, this task was tested using a metric (i.e., % steps correct) that we felt didn't adequately measure the "fine motor-continuous" aspects of the task. Consequently, we decided not to attempt to build a PSF for this taxon. Page 87 describes our approach for dealing with the lack of PSF for this taxon.

Gross motor - light.

Table 15 summarizes the tasks used to construct the performance measures for this taxon. We decided to use 11B since it was the only MOS with more than one task falling into this taxon.

Table 15

Description of Tasks Used in Constructing Taxon Measure: Gross Motor - Light

TAXON 3.2.2 MOS 11B

PROJECT A TASK CODE	TASK TITLE	TYPE	ACCURACY			TIME 1			FREQUENCY			RECENCY			OTHER			
			MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	NAME	MEAN	S.D.	N
FHB9	Engage Enemy Target with Hand Grenades	HoT	61.41	22.67	683	-	-	-	2.90	1.33	694	2.64	1.25	689	-	-	-	-
FHJ1	Tech. of Urban Terr. Movement	HoT	71.98	22.01	683	-	-	-	2.51	1.32	691	3.00	1.29	686	-	-	-	-

NOTE: In the column labeled TYPE, "HoT" represents Hands-On-Tasks in the Project A Concurrent Validity Database, and "Know" represents knowledge or paper and pencil tasks.

Gross motor - heavy.

No Project A tasks fell into this taxon. Performance for tasks falling into this taxon will be predicted using the materials handling models (see page 11).

Communication - oral.

Table 16 summarizes the tasks used to construct the performance measures for this taxon. Both 19E and 95B had two tasks falling into this taxon. We decided to use 19E since this MOS contained weapons system operators.

Table 16

Description of Tasks Used in Constructing Taxon Measure: Communication - Oral

TAXON 4.2 MOS 19E

PROJECT A TASK CODE	TASK TITLE	TYPE	ACCURACY			TIME 1			FREQUENCY			RECENCY			OTHER			
			MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	NAME	MEAN	S.D.	N
EHE6	Use an Automated CEOI	HoT	48.88	38.60	487	200.13	98.00	368	2.48	1.41	491	2.71	1.55	489	-	-	-	-
XHE7	Send a Radio Message	HoT	65.99	34.69	486	-	-	-	3.80	1.32	493	1.68	0.95	490	-	-	-	-

NOTE: In the column labeled TYPE, "HoT" represents Hands-On-Tasks in the Project A Concurrent Validity Database, and "Know" represents knowledge or paper and pencil tasks.

Communication - reading/writing.

Table 17 summarizes the tasks used to construct the performance measures for this taxon. 71L had the most hands-on tasks (3) falling into this taxon. In addition, 71L had a number of clearly relevant knowledge items which fell into this taxon (see Table 17). Most of these items involved reading and evaluating typed material.

Table 17

Description of Tasks Used in Constructing Taxon Measure: Communication - Reading and Writing

TAXON 4.1 MOS 71L

PROJECT A TASK CODE	TASK TITLE	TYPE	ACCURACY			TIME 1			FREQUENCY			RECENCY			OTHER			
			MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	MEAN	S.D.	N	NAME	MEAN	S.D.	N
AHH1	File Documents/Correspondence	HoT	82.99	19.69	495	651.24	300.05	436	4.03	1.53	507	1.76	1.29	504	-	-	-	-
AHH3	Prepare a Requisition for Publications/Blank Forms Using AUDOCIN (DA Form 4569)	HoT	60.22	30.07	495	683.[illegible]3	258.46	437	2.22	1.46	505	3.25	1.53	501	-	-	-	-
AHK2	Receipt/Transfer Classified Info.	HoT	26.52	26.39	498	692.03	434.70	424	1.70	1.31	504	3.92	1.48	501	-	-	-	-
AKH4	Establish Functional Files [PC Task]	Know	54.99	24.51	506	-	-	-	-	-	-	-	-	-	-	-	-	-
AKJ1	Dispatch Outgoing Dist [PC Task]	Know	35.98	17.19	508	-	-	-	-	-	-	-	-	-	-	-	-	-
AKJ3	Type 2nd Comment to Disposition Form [PC Task] [Taxon Measure Uses Frequency, Recency, and Time Values from AHJ3]	Know	67.99	26.79	508	-	-	-	3.15	1.65	508	2.25	1.44	506	-	-	-	-
AKJ4	Type Jt. Message Form [PC Task] [Taxon Measure Uses Frequency, Recency, and Time Values from AHJ4]	Know	60.97	28.89	506	-	-	-	2.04	1.4[illegible]	507	3.22	1.48	503	-	-	-	-
AKJ7	Type a Basic Comment to Disposition Form [PC Task] [Taxon Measure Uses Frequency, Recency, and Time Values from AHJ7]	Know	68.04	29.09	507	-	-	-	3.67	1.59	508	1.88	1.33	507	-	-	-	-
AKJ8	Assemble Correspondence [PC Task]	Know	40.83	27.31	507	-	-	-	-	-	-	-	-	-	-	-	-	-
AKJ9	Type Military Letter [PC Task] [Taxon Measure Uses Frequency, Recency, and Time Values from AHJ9]	Know	63.05	21.20	501	-	-	-	3.65	1.56	508	1.92	1.29	507	-	-	-	-

NOTE: In the column labeled TYPE, "HoT" represents Hands-On-Tasks in the Project A Concurrent Validity Database, and "Know" represents knowledge or paper and pencil tasks.

Construction of Criterion Measures

The objective of the PSF development effort was to develop functions to predict performance for different types of tasks as a function of personnel characteristics and training. We are interested in predicting performance for a task type rather than a specific individual task. Thus, our dependent measure was mean task performance for a particular task type rather than performance on a specific task.

To construct mean task performance measures for each taxon, we first developed standardized scores for each task by calculating the mean and standard deviation for the MOS on that task. We then took the mean of these standardized scores across the tasks falling into the taxon for a particular individual. We used standardized scores because tasks falling into the same taxon sometimes used different scales. For the most part, "% steps correct" was used as the criterion accuracy measure for Project A tasks. However, for a number of tasks, other scales (e.g., total targets correctly located) were used.

The same procedure was used to construct mean values for both time and accuracy: standardized scores were developed for each task and the standardized scores were averaged to create an overall taxon measure. Time values were not available for all Project A tasks; so in some cases the number of tasks used to construct the mean time values was different than the number of tasks used to calculate the mean accuracy values (see Table 10).

Construction of Predictor Measures

Table 18 summarizes the predictor variables used to develop the PSFs and the calculations, if any, that were needed to create these variables.

Construction of reading grade level score.

A reading grade level (RGL) score was calculated using a transformation table developed by Grafton (in press). The table lists values for converting scores on the GT ASVAB area composite to RGL.

Calculation of mean training frequency and recency scores.

Mean training frequency and recency scores were calculated for each taxon by averaging across the tasks which fell into that taxon. Frequency and recency scores were not available for all tasks. (See Table 19)

Table 18

Calculations Required to Construct Predictor Variables

PREDICTOR	CALCULATIONS REQUIRED
ASVAB Area Composites	None
Numerical Speed and Accuracy	None
Reading Grade Level	Derived from GT in Accordance with Grafton (in press)
Spatial	None
Complex Perceptual Accuracy	None
Complex Perceptual Speed	None
Psychomotor	None
Simple Reaction Speed	None
Simple Reaction Accuracy	None
Frequency	Calculated by Averaging Across Tasks in Taxon
Recency	Calculated by Averaging Across Tasks in Taxon
Frequency-Recency Interaction Term	Calculated by Multiplying Frequency and Recency Scores
Accuracy*	

* Used as a predictor for time only

Table 19

Mean Frequency and Recency Scores per Taxon

Taxon	MOS to be Used	Frequency MEAN	Frequency S.D.	Recency MEAN	Recency S.D.
Visual Recognition/ Discrimination	11B	2.87	1.45	2.60	1.37
Numerical Analysis	95B	2.55	0.94	2.75	0.85
Information Processing/ Problem Solving	31C	3.51	1.15	2.12	0.93
Fine Motor - Discrete	95B	3.34	0.86	2.15	0.69
Fine Motor - Continuous	PSF not yet determined				
Gross Motor - Heavy	PSF not yet determined				
Gross Motor - Light	11B	2.70	1.12	2.82	1.02
Communication - Reading and Writing	71L	2.93	0.93	2.60	0.82
Communication - Oral	19E	N/A	N/A	N/A	N/A

Construction of frequency-recency interaction term.

We hypothesized that there would be an interaction between training frequency and recency in terms of their impact on performance. For example, one might expect the impact of recency on performance to vary depending on how frequently the task was performed. To include this interaction in the PSFs, we constructed an interaction term by multiplying frequency and recency.

Results of Regression Analyses

Two sets of regression analyses were conducted to develop the PSFs for each taxon. In the first set of regression analyses, performance was predicted as a function of personnel characteristics and training without correcting for restriction of range in ASVAB area composites. In the second set of regression analyses, corrections for these factors were applied. The actual PSFs were constructed from the second set of analyses--that is, the analyses with the correction factors. Results from the first set of analyses are presented to show the impact of the correction factors.

Each set of analyses was conducted in the following manner:

Predictors.

A different set of predictors was used for each taxon (see Table 20). The predictors employed were based on the characteristic-taxon relationships described on page 21. Wherever data was available, frequency and recency and their interaction are used as predictors for each taxon. Actually, 10 separate regression analyses were conducted for each criterion corresponding to the 10 ASVAB area composites. This approach was taken so that PSFs would be available for any MOS regardless of which ASVAB area composite is used as a selection criteria for that MOS.

Criteria.

Separate sets of regression analyses were conducted to predict the accuracy and time measures for each taxon. Thus, 20 regression analyses were conducted for each taxon (10 ASVAB composites times 2 types of performance criteria.)

To predict accuracy, the predictors were entered in three "blocks." In the first block, the relevant ASVAB composite was entered. In the second block, of the training-related variables (frequency, recency, and frequency-recency interaction term) were entered into the equation. In the third block, a stepwise technique was used to determine which of the remaining predictors would enter the equation.

To predict time, the predictors were entered in four blocks. In the first block, the ASVAB composite was entered. In the second block, the training variables were entered. In the third block, the accuracy criterion was entered. In the fourth block, a stepwise technique was again used to determine which of the remaining predictors would enter the equation. Accuracy was used as a predictor of time because of the expected relationship

Table 20

Expected Predictors for Each Taxon

	Visual Recognition/ Discrimination		Numerical Analysis		Information Processing/Problem Solving		Fine Motor - Discrete		Fine Motor - Continuous		Gross Motor - Heavy		Gross Motor - Light		Communication - Reading & Writing		Communication - Oral	
	Accuracy	Time	Accuracy	Time	Accuracy	Time	Accuracy	Time	Accuracy	Time	Accuracy	Time	Accuracy	Time	Accuracy	Time	Accuracy	Time
ASVAB Composite	X	N/A[1]	X	X	X	X	X	X					X	X	X	X	X	X
Reading Grade Level															X	X		
Complex Perceptual Speed		N/A		X		X		X						X		X		X
Complex Perceptual Accuracy	X		X		X		X						X		X		X	
Overall Spatial	X	N/A	X	X	X	X	X	X	P.S.F. not yet developed				X	X	X	X	X	X
Numerical Speed & Accuracy			X	X														
Psychomotor							X	X			Materials Handling Models used		X	X			X	
Simple Reaction Speed		N/A		X		X		X						X		X		X
Simple Reaction Accuracy	X		X		X		X						X		X		X	
Training Frequency	X	N/A	X	X	X	X	X	X					X	X	X	X	N/A[2]	N/A[2]
Training Recency	X	N/A	X	X	X	X	X	X					X	X	X	X	N/A	N/A
Training Frequency X Recency Interaction	X	N/A	X	X	X	X	X	X					X	X	X	X	N/A	N/A
Accuracy		N/A		X		X		X						X		X		N/A

1 Time measures for Visual Recognition/Discrimination and Communication - Oral were not available

2 Training measures for Communication - Oral were not available

between time and accuracy. In PER-SEVAL, we intended to first predict accuracy and then predict time given the predicted accuracy value.

Results From Regression Analyses Without Correction Factors

Table 21 summarizes the results from the regression analyses **without the correction factors. In doing the regression analyses without the correction factors, predictors were forced** into the equation to mirror the results obtained from the analyses with the correction factors (see below).

Results From Regression Analyses With Correction Factors

Regression analyses were conducted with correction factors for restriction of range due to the use of ASVAB scores as a selection mechanism for entry into the Army and individual MOSs.

Correction for restriction of range.

Entrance into the Army is typically restricted to individuals who score above a minimum value on the Armed Forces Qualification Test (AFQT). The AFQT is a composite of four ASVAB subtests -- Arithmetic Reasoning, Word Knowledge, Paragraph Comprehension, and Numerical Operations. Once an individual is accepted into the Army, he or she is assigned to an MOS. However, entrance into the MOS is typically restricted to individuals who score above a minimum value on a particular ASVAB area composite. The ASVAB area composites are also composites of individual ASVAB subtests (Table 4 lists the subtests in each composite). Thus, restriction of range occurs at two levels--entrance into the Army and entrance into the MOS.

The procedure used to correct R for range restriction is one proposed by Lawley (1943) and described in Lord and Novick (1968). In applying the procedure, the variance-covariance matrix of the ASVAB composites for the 1980 youth population was computed using the variance-covariance matrix of the ASVAB subtests (Mitchell and Hanser, 1980). Table 22 lists these intercorrelations. The next step in the correction procedures was to adjust for the MOS selection criteria (i.e., the ASVAB composites). The variances and covariances for the ASVAB composites for each Project A MOS used in the analyses are listed in Appendix D.

Mathematical description of correction procedures.

In describing the equations for correcting for restriction of range or curtailment, we use the following notation:

Table 21

Summary of Results (Multiple Correlation) for Regression Analyses Without Corrections

ASVAB COMPOSITE	Visual Recognition/ Discrimination		Numerical Analysis		Information Processing/ Problem Solving		Fine Motor - Discrete		Gross Motor - Light		Communication - Reading and Writing		Communication - Oral	
	ACCURACY	TIME	ACCURACY	TIME	ACCURACY	TIME	ACCURACY	TIME	ACCURACY	TIME	ACCURACY	TIME	ACCURACY	TIME
Clerical/ Administrative (CL)	.31*	N/A	.39*	.31*	.46*	.23*	.38*	.49*	.17*	N/A	.61*	.17+	.16*	.18*
Combat (CO)	.30*	N/A	.40*	.32*	.43*	.23*	.38*	.48*	.17*	N/A	.60*	.17+	.23*	.18*
Electronics Repair (EL)	.32*	N/A	.40*	.31*	.45*	.23*	.39*	.49*	.17*	N/A	.60*	.21*	.20*	.18*
Field Artillery (FA)	.30*	N/A	.40*	.32*	.45*	.23*	.38*	.49*	.16*	N/A	.60*	.17+	.18*	.19*
General Maintenance (GM)	.33*	N/A	.39*	.31*	.45*	.24*	.40*	.48*	.18*	N/A	.60*	.18+	.19*	.17+
General Technical (GT)	.30*	N/A	.38*	.31*	.45*	.23*	.38*	.49*	.17*	N/A	.60*	.17+	.22*	.18*
Mechanical Maintenance (MM)	.31*	N/A	.39*	.31*	.43*	.23*	.40*	.49*	.17*	N/A	.60*	.17+	.20*	.15+
Operators/ Food (OF)	.32*	N/A	.38*	.32*	.43*	.23*	.39*	.49*	.18*	N/A	.60*	.17+	.18*	.17+
Surveillance/ Communications (SC)	.31*	N/A	.39*	.31*	.44*	.24*	.39*	.49*	.18*	N/A	.60*	.17+	.17*	.17*
Skilled Technical (ST)	.32*	N/A	.40*	.31*	.44*	.24*	.38*	.48*	.18*	N/A	.60*	.17+	.23*	.19*

* $p < .01$
+ $p < .05$

Table 22

Mean, Standard Deviations and Intercorrelations for Population Taking ASVAB: 1980 Reference Population Subtest Scores[a]

ASVAB Subtest (N = 9173)

	Arithmetic Reasoning AR	Word Knowledge WK	Paragraph Comprehension PC	Numerical Operations NO	General Science GS	Coding Speed CS	Auto & Shop Information AS	Mathematics Knowledge MK	Mechanical Comprehension MC	Electronics Information EI
AR	50.33[b] 10.25									
WK	.71	50.81 10.05								
PC	.67	.80	51.47 9.66							
NO	.63	.60	.60	48.56 10.65						
GS	.72	.80	.69	.52	49.63 9.69					
CS	.51	.55	.56	.70	.45	51.94 10.10				
AS	.53	.52	.42	.29	.64	.22	46.28 9.82			
MK	.83	.67	.64	.62	.69	.52	.41	51.64 10.77		
MC	.68	.59	.52	.40	.70	.33	.74	.60	47.55 9.58	
EI	.66	.68	.57	.41	.76	.34	.75	.58	.74	47.98 9.86

AR = Arithmetic Reasoning
WK = Word Knowledge
PC = Paragraph Comprehension
NO = Numerical Operations
GS = General Science
CS = Coding Speed
AS = Auto and Shop Information
MK = Mathematics Knowledge
MC = Mechanical Comprehension
EI = Electronics Information

[a] Restricted to persons in the sample born between January 1, 1957 and December 31, 1962 (18 through 23 years at time of testing, July-October 1980).
[b] Means and Standard Deviations along the diagonal. Means are slightly above the diagonal, and standard deviations are slightly below.

REFERENCE:

Office of the Assistant Secretary of Defense (OASD) [Manpower, Reserve Affairs, and Logistics]. (1982). Profile of American Youth: 1980 Nationwide Administration of the Armed Services Vocational Aptitude Battery.

x(X) - Variables on which explicit selection has taken place (corresponding variables in the uncurtailed population)

y(Y) - Variables on which incidental selection has taken place (corresponding variables in the uncurtailed population)

Sx(SX) - Variance covariance matrix of the variables on which explicit selection has taken place

Sy(SY) - Variance covariance matrix of the variables on which incidental selection has taken place

We make the following assumptions (Lawley, 1943; Lord and Novick, 1968):

(i) $E\ (Y \mid X) = E\ (y \mid x)$

(ii) $SY.X = Sy.x$

The first assumption is that the regression equations and, hence, the regression coefficients, are equal in the curtailed and the uncurtailed populations. Since the regression coefficients are given by the expression $B = SX-1\ SXY = Sx-1\ Sxy$, it follows that;

$$SXY = SX\ Sx-1\ Sxy$$

The residual, a partial variance-covariance matrix Sy.x is given by the expression:

$$Sy.x = SY - SYX\ SX-1\ SXY$$

Similarly,

$$Sy.x = Sy - Syx\ Sx-1\ Sxy$$

Thus,

$$SY - S'XY\ SX-1\ SXY = Sy - S'xy\ Sx-1\ Sxy$$

and, hence,

$$SY = Sy + S'XY\ SX-1\ SXY - S'xy\ Sx-1\ Sxy$$

or,

$$Sy = Sy + (S'XY - S'xy)\ Sx-1\ Sxy$$

when selection takes place, SX, Sx, Sxy, and Sy are known. Correcting for curtailment requires obtaining SY, and SXY so that the variance-covariance matrix of Y and X in the uncurtailed population can be obtained. Once this matrix is determined, the equation for predicting Y from X in the uncurtailed population can be determined.

In the present context, there are two possible definitions of the uncurtailed population: (a) the 1980 reference population and (b) the population of those selected to enter the Army. The equations given above can be used to correct for restriction of range for these two populations.

Since the 1980 reference population data only includes information on the relationships among subtests (i.e., standard deviations and means), it was necessary to estimate the relationships among the ASVAB composites for this same population. In making these estimates, we assumed that the composites were linear composites of the subtests. In actuality, the composite scores are derived from the subtests using equipercentile-equating techniques. These techniques involve using conversion tables that give slightly nonlinear translations of the "sum-of-subtest-standard" scores.

Results per Taxon

Results for the regression analyses of time and accuracy for each taxon are provided in the subsections that follow.

Visual recognition/discrimination.

Table 23 presents the regression analyses results for the accuracy measure. Note that time measures were not available in the Project A data base for this taxon.

Table 23

Summary of Regression Analyses (with Corrections) for Visual Recognition/Discrimination: Accuracy

		BETA WEIGHTS FOR PREDICTORS												
ASVAB COMPOSITE	MULTIPLE CORRELATION	ASVAB COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION	ACCURACY
Clerical/Administrative (CL)	.57	.29	-	-	.11	.22	-	-	-	-	-	-	-	-
Combat (CO)	.57	.32	-	-	.11	.20	-	-	-	-	-	-	-	-
Electronics Repair (EL)	.57	.34	-	-	.11	.18	-	-	-	-	-	-	-	-
Field Artillery (FA)	.57	.31	-	-	.11	.20	-	-	-	-	-	-	-	-
General Maintenance (GM)	.58	.34	-	-	.11	.19	-	-	-	-	-	-	-	-
General Technical (GT)	.57	.28	-	-	.11	.24	-	-	-	-	-	-	-	-
Mechanical Maintenance (MM)	.57	.31	-	-	.12	.21	-	-	-	-	-	-	-	-
Operators/Food (OF)	.58	.32	-	-	.11	.20	-	-	-	-	-	-	-	-
Surveillance/Communications (SC)	.57	.33	-	-	.11	.19	-	-	-	-	-	-	-	-
Skilled Technical (ST)	.58	.35	-	-	.10	.17	-	-	-	-	-	-	-	-

Cognitive - numerical.

Table 24 and 25 present the regression analyses results for the accuracy and time measures, respectively.

Table 24

Summary of Regression Analyses (with Corrections) for Cognitive - Numerical Analysis: Accuracy

ASVAB COMPOSITE	MULTIPLE CORRELATION	BETA WEIGHTS FOR PREDICTORS											
		ASVAB COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION
Clerical/Administrative (CL)	.86	.52	-	-	-	.31	-	-	-	-	.05	-.08	.02
Combat (CO)	.86	.56	-	-	-	.26	-	-	-	-	.02	-.11	.03
Electronics Repair (EL)	.86	.56	-	-	-	.27	-	-	-	-	.05	-.08	.01
Field Artillery (FA)	.86	.57	-	-	-	.25	-	-	-	-	.05	-.09	.02
General Maintenance (GM)	.86	.52	-	-	-	.31	-	-	-	-	.05	-.09	.01
General Technical (GT)	.86	.50	-	-	-	.33	-	-	-	-	.05	-.09	.03
Mechanical Maintenance (MM)	.86	.47	-	-	-	.35	-	-	-	-	.05	-.09	.01
Operators/Food (OF)	.86	.50	-	-	-	.32	-	-	-	-	.04	-.10	.03
Surveillance/Communications (SC)	.86	.56	-	-	-	.26	-	-	-	-	.03	-.10	.03
Skilled Technical (ST)	.86	.56	-	-	-	.27	-	-	-	-	.06	-.08	.01

Table 25

Summary of Regression Analyses (with Corrections) for Cognitive - Numerical Analysis: Time

		BETA WEIGHTS FOR PREDICTORS												
ASVAB COMPOSITE	MULTIPLE CORRELATION	ASVAB COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION	ACCURACY
Clerical/Administrative (CL)	.68	-.16	-	-	-	-.22	-	-	-.09	-	-.15	-.16	.09	-.29
Combat (CO)	.68	-.44	-	-	-	-		-	-	-	-.11	-.13	.05	-.28
Electronics Repair (EL)	.68	-.13	-	-	-	-.24	-	-	-.09	-	-.15	-.16	.09	-.30
Field Artillery (FA)	.64	-.39	-	-	-	-	-	-	-.06	-	-.14	-.15	.07	-.28
General Maintenance (GM)	.68	-.13	-	-	-	-.25	-	-	-.10	-	-.15	-.16	.09	-.30
General Technical (GT)	.68	-.15	-	-	-	-.23	-	-	-.09	-	-.14	-.16	.09	-.30
Mechanical Maintenance (MM)	.66	-.21	-	-	-	-.16	-	-	-.09	-	-.14	-.18	.09	-.28
Operators/Food (OF)	.68	-.13	-	-	-	-	-	-	-	-	-.12	-.13	.05	-.29
Surveillance/Communication (SC)	.68	-.21	-	-	-	-.18	-	-	-.09	-	-.14	-.15	.08	-.28
Skilled Technical (ST)	.68	-.20	-	-	-	-.20	-	-	-.09	-	-.15	-.16	.09	-.28

Cognitive - information processing/problem solving.

Table 26 and 27 present the regression analyses results for the accuracy and time measures, respectively.

Table 26

Summary of Regression Analyses (with Corrections) for Cognitive - Information Processing/Problem Solving: Accuracy

ASVAB COMPOSITE	MULTIPLE CORRELATION	BETA WEIGHTS FOR PREDICTORS: ASVAB COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION
Clerical/Administrative (CL)	.70	.55	-	-	.11	-	-	-	-	-	.03	-.24	.07
Combat (CO)	.70	.29	-	-	.10	.26	-	-	-	-	.01	-.30	.10
Electronics Repair (EL)	.70	.55	-	-	.10	-	-	-	-	-	.03	-.24	.07
Field Artillery (FA)	.70	.54	-	-	.11	-	-	-	-	-	.00	-.26	.08
General Maintenance (GM)	.70	.31	-	-	.10	.25	-	-	-	-	.00	-.28	.09
General Technical (GT)	.70	.33	-	-	.10	.23	-	-	-	-	.01	-.27	.09
Mechanical Maintenance (MM)	.68	.21	-	-	.10	.34	-	-	-	-	-.01	-.30	.10
Operators/Food (OF)	.69	.25	-	-	.10	.30	-	-	-	-	-.01	-.30	.10
Surveillance/Communications (SC)	.70	.27	-	-	.10	.28	-	-	-	-	-.01	-.29	.10
Skilled Technical (ST)	.70	.54	-	-	.11	-	-	-	-	-	.02	-.25	.07

Table 27

Summary of Regression Analyses (with Corrections) for Cognitive - Information Processing/Problem Solving: Time

ASVAS COMPOSITE	MULTIPLE CORRELATION	BETA WEIGHTS FOR PREDICTORS												
		ASVAS COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION	ACCURACY
Clerical/Administrative (CL)	.33	.15	-	-	-	-.44	-	-	-	-	-.00	.11	-.07	.03
Combat (CO)	.32	.12	-	-	-	-.43	-	-	-	-	-.02	.10	-.07	.04
Electronics Repair (EL)	.32	.17	-	-	-	-.47	-	-	-	-	-.00	.12	-.08	.03
Field Artillery (FA)	.32	.09	-	-	-	-.48	-	-	-	-	-.01	.10	-.07	.04
General Maintenance (GM)	.33	.18	-	-	-	-.47	-	-	-	-	-.01	.11	-.07	.03
General Technical (GT)	.33	.16	-	-	-	-.45	-	-	-	-	-.01	.11	-.07	.03
Mechanical Maintenance (MM)	.32	.11	-	-	-	-.42	-	-	-	-	-.02	.10	-.07	.04
Operators/Food (OF)	.32	.13	-	-	-	-.43	-	-	-	-	-.02	.10	-.07	.04
Surveillance/Communications (SC)	.33	.20	-	-	-	-.50	-	-	-	-	-.02	.11	-.07	.04
Skilled Technical (ST)	.33	.24	-	-	-	-.52	-	-	-	-	-.00	.12	-.08	.03

Fine motor - discrete.

Table 28 and 29 present the regression analyses results for the accuracy and time measures, respectively.

Table 28

Summary of Regression Analyses (with Corrections) for Fine Motor - Discrete: Accuracy

ASVAB COMPOSITE	MULTIPLE CORRELATION	BETA WEIGHTS FOR PREDICTORS: ASVAB COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION
Clerical/Administrative (CL)	.75	.20	-	-	-	.52	-	-	-	-	.30	.12	-.19
Combat (CO)	.76	.31	-	-	-	.42	-	-	-	-	.28	.09	-.16
Electronics Repair (EL)	.76	.23	-	-	-	.44	-	-	-	-	.29	.11	-.17
Field Artillery (FA)	.75	.25	-	-	-	.47	-	-	-	-	.30	.11	-.18
General Maintenance (GM)	.76	.33	-	-	-	.41	-	-	-	-	.28	.09	-.16
General Technical (GT)	.75	.16	-	-	-	.55	-	-	-	-	.31	.13	-.20
Mechanical Maintenance (MM)	.76	.34	-	-	-	.40	-	-	-	-	.28	.10	-.16
Operators/Food (OF)	.76	.32	-	-	-	.41	-	-	-	-	.28	.10	-.16
Surveillance/Communications (SC)	.76	.31	-	-	-	.42	-	-	-	-	.28	.10	-.16
Skilled Technical (ST)	.76	.29	-	-	-	.44	-	-	-	-	.28	.10	-.17

Table 29

Summary of Regression Analyses (with Corrections) for Fine Motor - Discrete: Time

		BETA WEIGHTS FOR PREDICTORS												
ASVAB COMPOSITE	MULTIPLE CORRELATION	ASVAB COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION	ACCURACY
Clerical/Administrative (CL)	.72	-.04	-	-.87	-	-.13	-	-	-	-	.12	.13	-.15	-.49
Combat (CO)	.72	-.25	-	-.88	-		-	-	-	-	.15	.17	-.20	-.46
Electronics Repair (EL)	.72	-.12	-	-.87	-	-.16	-	-	-	-	.12	.14	-.17	-.48
Field Artillery (FA)	.72	-.04	-	-.87	-	-.23	-	-	-	-	.12	.13	-.15	-.49
General Maintenance (GM)	.72	-.27	-	-.88	-	-	-	-	-	-	.15	.16	-.20	-.48
General Technical (GT)	.72	-.09	-	-.87	-	-.19	-	-	-	-	.12	.13	-.16	-.48
Mechanical Maintenance (MM)	.73	-.25	-	-.86	-	-	-	-	-	-	.14	.17	-.19	-.47
Operators/Food (OF)	.72	-.27	-	-.88	-	-	-	-	-	-	.15	.17	-.20	-.48
Surveillance/Communications (SC)	.72	-.27	-	-.88	-	-	-	-	-	-	.16	.17	-.20	-.48
Skilled Technical (ST)	.72	-.12	-	-.88	-	-.15	-	-	-	-	.13	.14	-.17	-.48

Gross motor - light.

Table 30 presents the regression analyses results for the accuracy measure. Note that time measures were not available in the Project A data base for this taxon.

Table 30

Summary of Regression Analyses (with Corrections) for Gross Motor - Light: Accuracy

		BETA WEIGHTS FOR PREDICTORS											
ASVAB COMPOSITE	MULTIPLE CORRELATION	ASVAB COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION
Clerical/Administrative (CL)	.31	.20	-	-	-	-	-	.15	-	-	-.05	-.09	.05
Combat (CO)	.32	.22	-	-	-	-	-	.13	-	-	-.04	-.08	.05
Electronics Repair (EL)	.31	.20	-	-	-	-	-	.15	-	-	-.04	-.08	.05
Field Artillery (FA)	.31	.20	-	-	-	-	-	.14	-	-	-.05	-.08	.05
General Maintenance (GM)	.32	.22	-	-	-	-	-	.14	-	-	-.03	-.08	.04
General Technical (GT)	.31	.18	-	-	-	-	-	.15	-	-	-.05	-.09	.05
Mechanical Maintenance (MM)	.32	.21	-	-	-	-	-	.14	-	-	-.04	-.08	.04
Operators/Food (OF)	.32	.23	-	-	-	-	-	.13	-	-	-.03	-.08	.04
Surveillance/Communications (SC)	.32	.22	-	-	-	-	-	.14	-	-	-.04	-.08	.04
Skilled Technical (ST)	.32	.22	-	-	-	-	-	.14	-	-	-.03	-.07	.03

Communication - oral.

Table 31 and 32 present the regression analyses results for the accuracy and time measures, respectively.

Table 31

Summary of Regression Analyses (with Corrections) for Communication - Oral: Accuracy

ASVAB COMPOSITE	MULTIPLE CORRELATION	BETA WEIGHTS FOR PREDICTORS											
		ASVAB COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION
Clerical/Administrative (CL)	.40	.40	-	-	-	-	-	-	-	-	-	-	-
Combat (CO)	.40	.20	-	-	-	.22	-	-	-	-	-	-	-
Electronics Repair (EL)	.40	.40	-	-	-	-	-	-	-	-	-	-	-
Field Artillery (FA)	.40	.40	-	-	-	-	-	-	-	-	-	-	-
General Maintenance (GM)	.40	.41	-	-	-	-	-	-	-	-	-	-	-
General Technical (GT)	.40	.20	-	-	-	.22	-	-	-	-	-	-	-
Mechanical Maintenance (MM)	.41	.41	-	-	-	-	-	-	-	-	-	-	-
Operators/Food (OF)	.40	.40	-	-	-	-	-	-	-	-	-	-	-
Surveillance/Communications (SC)	.41	.41	-	-	-	-	-	-	-	-	-	-	-
Skilled Technical (ST)	.40	.21	-	-	-	.20	-	-	-	-	-	-	-

Table 32

Summary of Regression Analyses (with Corrections) for Communication - Oral: Time

		BETA WEIGHTS FOR PREDICTORS												
ASVAS COMPOSITE	MULTIPLE CORRELATION	ASVAS COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION	ACCURACY
Clerical/Administrative (CL)	.31	-.29	-	-	-	-	-	-	-.11	-	-	-	-	.09
Combat (CO)	.31	-.29	-	-	-	-	-	-	-.11	-	-	-	-	.08
Electronics Repair (EL)	.31	-.29	-	-	-	-	-	-	-.11	-	-	-	-	.08
Field Artillery (FA)	.31	-.29	-	-	-	-	-	-	-.10	-	-	-	-	.08
General Maintenance (GM)	.30	-.28	-	-	-	-	-	-	-.12	-	-	-	-	.09
General Technical (GT)	.31	-.29	-	-	-	-	-	-	-.11	-	-	-	-	.08
Mechanical Maintenance (MM)	.30	-.27	-	-	-	-	-	-	-.12	-	-	-	-	.08
Operators/Food (OF)	.30	-.28	-	-	-	-	-	-	-.12	-	-	-	-	.08
Surveillance/Communications (SC)	.31	-.29	-	-	-	-	-	-	-.12	-	-	-	-	.06
Skilled Technical (ST)	.32	-.30	-	-	-	-	-	-	-.11	-	-	-	-	.09

Communication - reading/writing.

Table 33 and 34 present the regression analyses results for the accuracy and time measures, respectively.

Table 33

Summary of Regression Analyses (with Corrections) for Communication - Reading and Writing: Accuracy

ASVAB COMPOSITE	MULTIPLE CORRELATION	BETA WEIGHTS FOR PREDICTORS											
		ASVAB COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION
Clerical/Administrative (CL)	.85	.46	-	-	.12	.30	-	-	-	-	.09	-.12	.05
Combat (CO)	.84	-.08	.46	-	.12	.37	-	-	-	-	.08	-.13	.06
Electronics Repair (EL)	.84	.04	.38	-	.21	.34	-	-	-	-	.07	-.14	.06
Field Artillery (FA)	.84	.17	.29	-	.12	.30	-	-	-	-	.08	-.13	.06
General Maintenance (GM)	.84	-.05	.45	-	.12	.35	-	-	-	-	.07	-.14	.06
General Technical (GT)	.84	.41	-	-	.12	.34	-	-	-	-	.08	-.14	.06
Mechanical Maintenance (MM)	.85	-.11	.48	-	.12	.38	-	-	-	-	.07	-.13	.06
Operators/Food (OF)	.84	-.12	.50	-	.12	.37	-	-	-	-	.07	-.14	.06
Surveillance/Communications (SC)	.85	-.29	.64	-	.12	.40	-	-	-	-	.08	-.13	.06
Skilled Technical (ST)	.84	-.04	.44	-	.12	.35	-	-	-	-	.07	-.14	.06

Table 34

Summary of Regression Analyses (with Corrections) for Communication - Reading and Writing: Time

		BETA WEIGHTS FOR PREDICTORS												
ASVAB COMPOSITE	MULTIPLE CORRELATION	ASVAB COMPOSITE	READING GRADE LEVEL	COMPLEX PERCEPTUAL SPEED	COMPLEX PERCEPTUAL ACCURACY	OVERALL SPATIAL	NUMERICAL SPEED & ACCURACY	PSYCHO-MOTOR	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	TRAINING FREQUENCY	TRAINING RECENCY	TRAINING FREQUENCY X RECENCY INTERACTION	ACCURACY
Clerical/Administrative (CL)	.19	.05	-	-	-	-	-	-	-	-	-.25	-.12	.09	-.13
Combat (CO)	.19	.03	-	-	-	-	-	-	-	-	-.25	-.12	.09	-.12
Electronics Repair (EL)	.23	.04	.54	-	-	-	-	-	-	-	-.22	-.13	.08	-.14
Field Artillery (FA)	.19	.05	-	-	-	-	-	-	-	-	-.25	-.12	.09	-.14
General Maintenance (GM)	.20	.10	-	-	-	-	-	-	-	-	-.26	-.14	.11	-.17
General Technical (GT)	.19	.02	-	-	-	-	-	-	-	-	-.25	-.11	.00	-.11
Mechanical Maintenance (MM)	.19	.09	-	-	-	-	-	-	-	-	-.26	-.13	.10	-.15
Operators/Food (OF)	.19	.03	-	-	-	-	-	-	-	-	-.24	-.11	.09	-.12
Surveillance/Communications (SC)	.19	.05	-	-	-	-	-	-	-	-	-.25	-.12	.10	-.14
Skilled Technical (ST)	.19	.07	-	-	-	-	-	-	-	-	-.25	-.12	.10	-.15

Summary of results.

Table 35 summarizes the results from the regression analyses with the correction factors. Tables 36 and 37 provide comparisons with the regression analyses which were done without the correction factors for time and accuracy, respectively.

Table 35

Summary of Results (Multiple Correlation) for Regression Analyses with Corrections

ASVAB COMPOSITE	Visual Recognition/ Discrimination		Numerical Analysis		Information Processing/ Problem Solving		Fine Motor - Discrete		Gross Motor - Light		Communication - Reading and Writing		Communication - Oral	
	ACCURACY	TIME	ACCURACY	TIME	ACCURACY	TIME	ACCURACY	TIME	ACCURACY	TIME	ACCURACY	TIME	ACCURACY	TIME
Clerical/ Administrative (CL)	.57*	N/A	.86*	.68*	.70*	.33*	.75*	.72*	.31*	N/A	.85*	.19*	.40*	.31*
Combat (CO)	.57*	N/A	.86*	.68*	.70*	.32*	.76*	.72*	.32*	N/A	.84*	.19*	.40*	.31*
Electronics Repair (EL)	.57*	N/A	.86*	.68*	.70*	.32*	.76*	.72*	.31*	N/A	.84*	.23*	.40*	.31*
Field Artillery (FA)	.57*	N/A	.86*	.68*	.70*	.32*	.75*	.72*	.31*	N/A	.84*	.19*	.40*	.31*
General Maintenance (GM)	.58*	N/A	.86*	.68*	.70*	.33*	.76*	.72*	.32*	N/A	.84*	.20*	.40*	.30*
General Technical (GT)	.57*	N/A	.86*	.68*	.70*	.33*	.75*	.72*	.31*	N/A	.84*	.19*	.40*	.31*
Mechanical Maintenance (MM)	.57*	N/A	.86*	.68*	.69*	.32*	.76*	.73*	.32*	N/A	.85*	.19*	.41*	.30*
Operators/ Food (OF)	.58*	N/A	.85*	.68*	.69*	.32*	.76*	.72*	.32*	N/A	.84*	.19*	.40*	.30*
Surveillance/ Communications (SC)	.57*	N/A	.86*	.68*	.70*	.33*	.76*	.72*	.32*	N/A	.85*	.19*	.41*	.31*
Skilled Technical (ST)	.58*	N/A	.86*	.68*	.70*	.33*	.76*	.72*	.32*	N/A	.84*	.19*	.40*	.32*

* $p < .01$
\+ $p < .05$

Table 36

Comparison of Results (Multiple Correlations) Without and With Correction Factors: Time

ASVAB COMPOSITE	Visual Recognition/ Discrimination		Numerical Analysis		Information Processing/ Problem Solving		Fine Motor - Discrete		Gross Motor - Light		Communication - Reading and Writing		Communication - Oral	
	WITHOUT	WITH	WITHOUT	WITH	WITHOUT	WITH	WITHOUT	WITH	WITHOUT	WITH	WITHOUT	WITH	WITHOUT	WITH
Clerical/ Administrative (CL)	N/A	N/A	.39	.68*	.23*	.33*	.49*	.72*	N/A	N/A	.17+	.19*	.18*	.31*
Combat (CO)	N/A	N/A	.40	.68*	.23*	.32*	.48*	.72*	N/A	N/A	.17+	.19*	.18*	.31*
Electronics Repair (EL)	N/A	N/A	.40	.68*	.23*	.32*	.49*	.72*	N/A	N/A	.21*	.23*	.18*	.31*
Field Artillery (FA)	N/A	N/A	.40	.68*	.23*	.32*	.49*	.72*	N/A	N/A	.17+	.19*	.19*	.31*
General Maintenance (GM)	N/A	N/A	.39	.68*	.24*	.33*	.48*	.72*	N/A	N/A	.18+	.20*	.17+	.30*
General Technical (GT)	N/A	N/A	.38	.68*	.23*	.33*	.49*	.72*	N/A	N/A	.17+	.19*	.18*	.31*
Mechanical Maintenance (MM)	N/A	N/A	.39	.68*	.23*	.32*	.49*	.73*	N/A	N/A	.17+	.19*	.15+	.30*
Operators/ Food (OF)	N/A	N/A	.38	.68*	.23*	.32*	.49*	.72*	N/A	N/A	.17+	.19*	.17+	.30*
Surveillance/ Communications (SC)	N/A	N/A	.39	.68*	.24*	.33*	.49*	.72*	N/A	N/A	.17+	.19*	.17*	.31*
Skilled Technical (ST)	N/A	N/A	.40	.68*	.24*	.33*	.48*	.72*	N/A	N/A	.17+	.19*	.19*	.32*

* $P < .01$
+ $P < .05$

Table 37

Comparison of Results (Multiple Correlations) Without and With Correction Factors: Accuracy

ASVAB COMPOSITE	Visual Recognition/ Discrimination		Numerical Analysis		Information Processing/ Problem Solving		Fine Motor - Discrete		Gross Motor - Light		Communication - Reading and Writing		Communication - Oral	
	WITHOUT	WITH	WITHOUT	WITH	WITHOUT	WITH	WITHOUT	WITH	WITHOUT	WITH	WITHOUT	WITH	WITHOUT	WITH
Clerical/ Administrative (CL)	.31	.57	.39	.86	.46	.70	.38	.75	.17	.31	.61	.85	.16	.40
Combat (CO)	.30	.57	.40	.86	.43	.70	.38	.76	.17	.32	.60	.84	.23	.40
Electronics Repair (EL)	.32	.57	.40	.86	.45	.70	.39	.76	.17	.31	.60	.84	.20	.40
Field Artillery (FA)	.30	.57	.40	.86	.45	.70	.38	.75	.16	.31	.60	.84	.18	.40
General Maintenance (GM)	.33	.58	.39	.86	.45	.70	.40	.76	.18	.32	.60	.84	.19	.40
General Technical (GT)	.30	.57	.38	.86	.45	.70	.38	.75	.17	.31	.60	.84	.22	.40
Mechanical Maintenance (MM)	.31	.57	.39	.86	.43	.69	.40	.76	.17	.32	.60	.85	.20	.41
Operators/ Food (OF)	.32	.58	.38	.86	.43	.69	.39	.76	.18	.32	.60	.84	.18	.40
Surveillance/ Communications (SC)	.31	.57	.39	.86	.44	.70	.39	.76	.18	.32	.60	.85	.17	.41
Skilled Technical (ST)	.32	.58	.40	.86	.44	.70	.38	.76	.18	.32	.60	.84	.23	.40

Description of How the PSFs Will Be Used

Figure 4 provides an overview of how the PSFs will be applied in PER-SEVAL. In the initial steps of a PER-SEVAL application, users provide the input information needed to apply a PSF. To do this, they first assign the duty positions associated with a new weapon system to an MOS. These duty positions were constructed as part of the MAN-SEVAL application. As part of this process a user may identify a new MOS. Once an MOS has been identified, the system will identify an ASVAB composite for that MOS and expected cut-off and mean levels for that composite. The user is then asked to assign each operator and maintainer task to one or more of the MPT^2 taxons using the taxon definitions provided in Appendix A as a guide. Each task can be assigned to a maximum of three taxons. Users will also estimate the expected percentage of task elements involving each taxon.

In the next step of a PER-SEVAL application, the user describes how frequently the task will be performed on the job. The system then converts this information into estimates of frequency and recency of performance. (The PER-SEVAL design specifications describe this conversion process in detail.) In a later PER-SEVAL step, the system will ask a series of questions that are designed to elicit from users the minimum information needed to estimate the mean level of performance that can be expected given (a) a particular contractor's hardware/software design and (b) the expected quality of the population who will perform the task (i.e., the level of the relevant ASVAB area composite). Page 81 outlines the process that will be employed to obtain these mean values.

Once the taxon assignments have been made and the mean performance values have been obtained, PER-SEVAL begins the process of identifying the minimum level of the ASVAB area composite that will provide the desired performance level--that is the level that will meet the performance requirements identified by SPARC, one of the other MANPRINT aids. There are two components to these performance requirements--a standard which describes the quantitative level of performance that must be achieved and a criterion that describes the percentage of time that level must be achieved. PER-SEVAL identifies the minimum ASVAB area composite by iteratively changing the composite score, calculating the impact of this change on other personnel characteristics, and then using the PSF to estimate expected task performance at the new predictor levels.

The next section provides several examples of how the PSFs will be applied once taxon assignments, mean performance levels, and revised predictor values have been determined. In subsequent

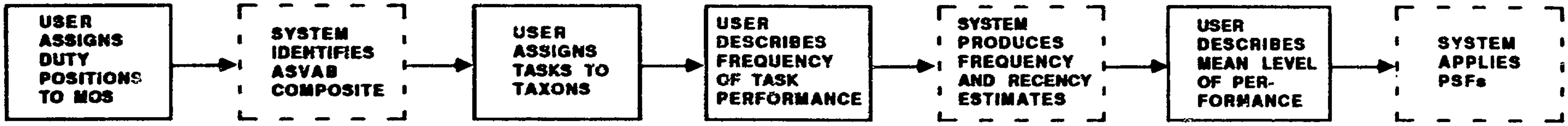


Figure 4. Overview of PSF application.

sections, procedures for estimating the mean performance levels and revised predictor values are outlined.

Example of PSF Application

In this section, we present an example of how the PSFs will be used to predict task performance. The example employs data from the Project A data base. The task used in this example is "Start and Stop a Tank."

The PSFs are applied in a three step process. First, the raw score for the predictor variables are converted to standardized scores. Second, a standardized criterion score is predicted by multiplying each standardized predictor by its beta weight (from the PSFs) and summing the result. Third, the standardized criterion is converted to a raw score. Note that the mean criterion value used in this conversion is supplied by the user. Table 38 displays the results of each of these steps for the example task.

Predictions for task time will be calculated in a similar manner except that task accuracy will be included as a predictor variable. Thus, the accuracy score for a particular task is predicted prior to the time score for that task.

In some cases, a single task may be assigned to several taxons. In these cases, predictions are made for each taxon and a weighted average is calculated, weighing each taxon prediction by the percentage value assigned that taxon by the user.

Assumptions in Applying PSFs

A number of assumptions underlie application of the PSF in the manner described above. The key assumptions are as follows:

1) The PSFs we have developed for a taxon can be applied to any task which is placed in that taxon;

2) The same predictor-criterion relationships apply over different levels of the predictors and the performance measure;

3) Predictor-Criterion relationships do not vary as a function of other personnel characteristics or other variables;

4) Users can reliably assign the tasks to taxons and provide the information needed to estimate mean performance levels;

Table 38

Example PSF Application

TASK (AHH3) PREPARE A REQUISITION

MOS 71L

1. CONVERT RAW PREDICTOR SCORES TO STANDARDIZED PREDICTOR SCORES

	ACCURACY	ASVAB CL	COMPLEX PERCEPTUAL ACCURACY	COMPLEX PERCEPTUAL SPEED	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	SPATIAL	READING GRADE LEVEL	FREQUENCY	RECENCY	FREQUENCY X RECENCY
RAW SCORES (INDIVIDUAL)	-	112	160	-48	-1	108	314	11.3	3.14	2.29	7.18
MEAN (MOS 71L)	60.2	103.8	155.4	-51.9	1.48	102.1	291.3	9.9	2.9	2.6	7.0
S.D. (MOS 71L)	30.1	12.6	19.3	21.9	17.3	14.3	41.4	1.5	.9	.8	1.7
STANDARD SCORE (INDIVIDUAL)	.01	0.65	.24	.18	-.14	.41	.55	.95	.23	-.38	.12

2. APPLY BETA WEIGHTS

	ASVAB	COMPLEX PERCEPTUAL ACCURACY	COMPLEX PERCEPTUAL SPEED	SIMPLE REACTION SPEED	SIMPLE REACTION ACCURACY	SPATIAL	READING GRADE LEVEL	FREQUENCY	RECENCY	FREQUENCY X RECENCY	
BETA WEIGHT (MOS 71L)	.353	.169	.004	.035	-.016	.249	-.130	.122	-.195	.075	
BETA X STANDARD SCORE (INDIVIDUAL)	.229	.040	.0007	.005	-.007	.137	-.123	.028	.074	.009	= .3927

3. ESTIMATE RAW CRITERION SCORE:

WHERE:

X = (PREDICTED STANDARDIZED CRITERION X S.D.) + MEAN

71.7 = (.3927 · 30.1) + 60.2

71.7 = PREDICTED CRITERION SCORE

5) The corrections for restrictions of range are based on the following statistical assumptions.

The two sets of prediction equations relating the performance of a task in a given taxon to the scores on the predictor variables were developed using (a) the reference population, and (b) the population of those selected for an MOS. In developing these equations it was assumed that:

$$\text{(i)} \quad E(Y \mid X) = E(y \mid x)$$

where Y is the criterion score in the unselected population (a) or (b) and y is the corresponding score for those who have been selected into a MOS. Similarly X is the predictor score in the unselected population (a) or (b) and x is the predictor score for those selected into a MOS.

The second assumption is:

$$\text{(ii)} \quad \sigma_{2Y|X} = \sigma_{2y|x}$$

i.e., the variance of Y partialling out the effect of X in the unselected population is the same as the variance of y partialling out the effect of x in the population selected into a MOS.

These two assumptions are given in terms of a single criterion variable and a single predictor variable. These immediately generalize to the multivariate case and provide the basis for correcting for restriction of range.

Methods for Eliciting Mean Performance Values

In estimating mean task performance within the framework described here, there are three factors that must be considered--the difficulty of the task as determined by the hardware/software design, the overall capabilities of the population performing the task, and the sustainment training opportunities provided to this population (i.e., frequency and recency of task performance). Within the PER-SEVAL framework, we assume that the "overall capabilities of the population" are primarily determined by one type of personnel characteristic--the ASVAB area composite used to control entry into the MOS. We assume that the distribution of the other personnel characteristics (e.g., the new Project A predictors) are determined by the cut-off level selected for the ASVAB area composite. Hence, when identifying a reference population to make the mean judgement, the user has to consider only one personnel characteristic--ASVAB area composite.

Despite this simplification, making a direct judgement of the mean taking into account these three factors is a complex process. The PER-SEVAL program is designed to minimize the complexity of

this process. There are three situations under which the mean values could be obtained (see Figure 5).

First, because PER-SEVAL is designed to be applied later in the acquisition process, it is possible that performance data will be available for the task from test and evaluation. As part of the test and evaluation, data could be collected on mean task time and accuracy, the mean and standard deviation of the ASVAB area composite of the soldiers performing the task, and the training frequency and recency prior to task performance. This information is all that is needed to derive the necessary inputs for the PSFs (see Figure 5).

In the second and third situations, we assume that empirical data on task performance is not available. In the second situation, we assume that the task whose performance we are attempting to predict is measured on the same scale as the Project A tasks (i.e., percent steps correct). In this situation, the system first estimates scores for all personnel characteristics other than ASVAB area composite (scores for the composite were identified in an earlier step). Information on the existing or projected distribution of the other personnel characteristics at various levels of the ASVAB area composite will be available in the PER-SEVAL files. (The projected distributions would be predicted by P-CON.) This information can be used to generate expected mean scores for the non-ASVAB characteristics at a given cut-off level of the ASVAB composite. The user next rates the expected mean level of performance using a behaviorally-anchored rating scale (see Figure 6). The anchors on this scale would depict expected performance levels for Project A tasks falling into that taxon. These levels would be predicted using the PSFs and the predictor values described above as input. It should be noted that this scale should be appropriate for most fine motor-discrete tasks since "% steps correct" is the metric most often used to measure performance on these tasks. Based on previous analyses, we expect 30 to 60 percent of weapon systems tasks fall into the fine motor-discrete taxon. It should also be noted that as PER-SEVAL is applied to a large number of weapon systems, it will be possible to build task difficulty rating scales using metrics other than the Project A "% steps correct" metric. Once the user has input the mean values, he is then asked to enter the expected minimum (5th percentile) and maximum (95th percentile) values for task performance. This information is used to generate a standard deviation for the task.

In the third situation, we assume that the new task is not measured on the same scale as the Project A tasks (i.e., not measured on the % steps correct metric). In these situations, the user follows procedures similar to those described above (see Figure 5). However, rather than using the BARS scales, the user makes direct estimates of mean performance given a mean ASVAB area

composite level and expected frequency of performance on the job. For assistance, a user can ask the system to show what level of performance was achieved on other tasks falling into that taxon given the same levels of ASVAB area composite and frequency of performance. As in the second situation, the user is asked to enter the expected minimum (5th percentile) and maximum (95th percentile) values for the task to provide the information needed to estimate the standard deviation for task performance.

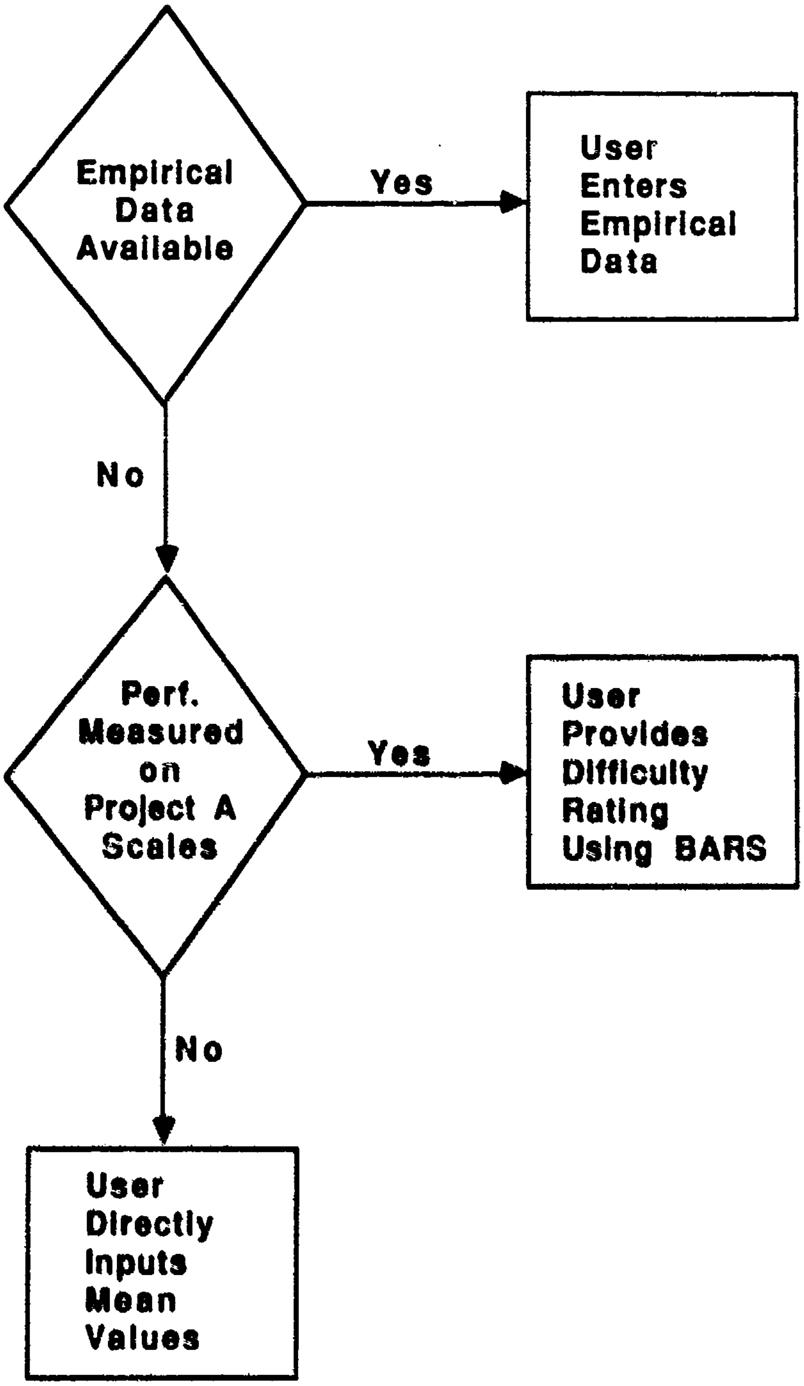


Figure 5. Methods for eliciting mean performance values.

TASK: Start M1A1 Tank Engine MOS: 19E

TASK TYPE: Fine Motor - Discrete EXPECTED SCORE: XXX

ASVAB COMPOSITE: Combat (CO)

EXPECTED FREQUENCY OF PERFORMANCE ON THE JOB: Once a Month

Estimate expected % steps correct for task listed above. Examples of performance levels for other Fine Motor - Discrete tasks are listed below to assist you.

% STEPS CORRECT

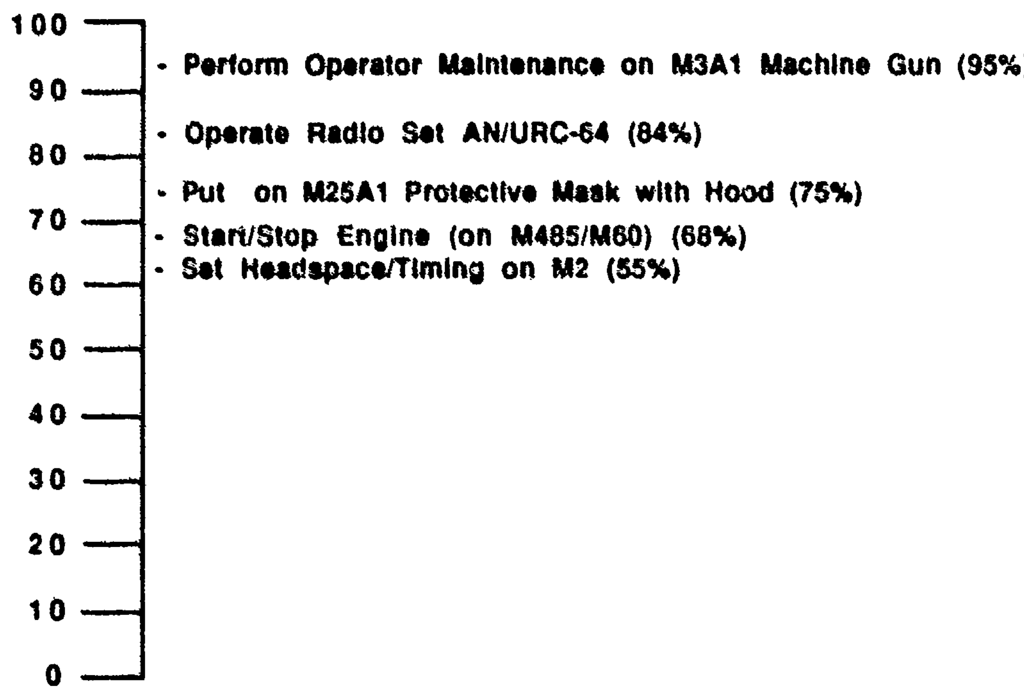


Figure 6. Format for behaviorally anchored rating scale.

Potential Techniques for Validating the PSFs and Associated Concepts

As noted in the introduction, resource limitations prohibited us from validating the PSFs and associated concepts. In this section, we briefly outline key concepts related to PSF application that should be validated and possible validation techniques.

To "validate" the PSF concepts outlined in this paper, there are four key questions that must be answered.

1) Can users make reliable taxon assignments?

2) Can users make reliable and valid estimates of mean performance?

3) Do the PSFs accurately predict task performance? If partially successful, under what circumstances are they successful?

4) Is the PER-SEVAL task taxonomy an accurate representation of soldier tasks?

5) What is the impact of task performance reliability on the PER-SEVAL estimates?

Question #3 is, of course, the most critical and the ultimate validation question in a psychometric sense. Furthermore, we would argue that if the answer to the first three questions is yes, we would not need to know the answer to the fourth question since the ultimate value of a taxonomy is determined by its utility in predicting performance.

Techniques for Measuring the Reliability of Taxon Assignments

The reliability of the PER-SEVAL taxon assignment process can be tested as follows. A group of Army personnel from the same population as the expected PER-SEVAL users can be asked to make taxon assignments for a large number of Army tasks using the portion of PER-SEVAL that assists users in making these judgments. These users would be asked to assign the same set of tasks. Two measures of the "agreement" of task taxon assignment could then be constructed. One measure would assess the percentage of time a task is placed into the same taxon. (The actual measure to be used would be a coefficient of inter-rater reliability.) The other measure would examine the reliability of the taxon percentage assignments. It would be constructed by correlating taxon percentage scores for tasks assigned to the same taxon.

If, as a result of the above analyses, it is found that users are confusing two taxons, improved techniques for describing these taxons should be developed and re-tested. If such techniques are not possible, the taxons should be merged or rearranged.

Techniques for Measuring the Reliability and Validity of the Mean Performance Estimates

Reliability assessment.

The reliability of the PER-SEVAL mean performance estimation process can be tested as follows. A group of Army personnel from the same population as the expected PER-SEVAL users can be asked to make mean performance estimates for a large number of Army tasks using the portion of PER-SEVAL that assists users in making these judgments. Users would be asked to make estimates for the same set of tasks. Correlations between the task estimates could then be examined.

Validity assessment.

The validity of the mean estimates could be assessed by comparing the estimated mean performance estimates with actual values from empirical data. To do this, tasks with existing empirical data would have to be compared with task performance estimates generated by the procedures described above.

Techniques for Validating PSF Performance Prediction Estimates

The PSFs can be used to make performance predictions for a sample of individual soldiers on a number of tasks within a taxon. These predictions can be correlated with actual performance on the tasks. Validation of this type could readily be made using data from the Project A data base. To do this, one would attempt to predict performance on tasks that were not included in the original PSF development effort.

Impact of Task Performance Reliability on PER-SEVAL Estimates

The reliability of hands-on performance tests for individual tasks is relatively low. For example, for the Project A hands-on performance measures, Campell, Campell, Rumsey, and Edwards (1985) report split-half reliabilities for individual tasks that range from .35 to .82 across MOSs. Currently PER-SEVAL produces point estimation of performance for individual tasks that assume perfect reliability. Ideally, if information on the reliability of task performance measures for new systems was available, these point estimates could be converted to interval estimates that would reflect the measures' reliability. Modification of PER-SEVAL to accommodate changes in task performance reliability should be considered in future HARDMAN III improvement programs.

Potential Techniques for Improving the PSFs

In addition to the validation program described on page 87, there are several other studies that could be undertaken to improve the PSFs. As the discussion on page 21 and 47 indicates, at this time we were not able to develop PSFs for several types of tasks. There were several reasons for this. First, the Project A data base lacked data on several different task types related to system performance. In particular, the Project A data base contains one fine motor-continuous task and only a few visual recognition/discrimination tasks. Second, for some task types, particularly those with a small number of tasks, the predictor-performance relationships were weak (see Table 39). Third, for all but a handful of tasks the performance measure used in Project A is "% go"--that is, the number of steps in a task of which the soldier got a "go," divided by the total number of steps in a task. While this measure is directly relevant to fine motor-discrete tasks, it is less relevant to other types of tasks such as fine motor-continuous tasks. For example, performance measures more relevant to fine motor-continuous tasks are "percent hits" (for shooting), root mean square deviation from ideal flight path (for piloting). Measures of this type typically can only be collected in the actual vehicles or in simulators. Because its primary focus was job performance and not weapon system performance, Project A focused its hands-on assessments to tasks at the soldier's home base.

In future efforts, we recommend that ARI develop more performance shaping functions by collecting additional empirical data from man-in-the-loop simulations at Army simulation facilities. These additional functions would be designed to provide data on the task types not covered adequately in the Project A data base. They could also be designed to provide data on the relationship between performance and key training variables not included in the current PER-SEVAL. For example, PER-SEVAL estimates training as a function of the frequency and recency of performing the task on the job or in sustainment training (these are the training variables most related to training on the job and the only training variables available in the Project A data base). Other key training variables (type and amount of institutional training) are not included in the PER-SEVAL.

We believe that there are a number of simulators which could provide the type of data needed by the PER-SEVAL performance shaping functions. One such simulator is the Realistic Air Defense Engagement System (RADES). RADES is an air defense simulator consisting of subscale aircraft, an aircraft position/location system, actual air defense weapon systems (e.g., Chaparral, Improved Chaparral, Self-Propelled Vulcan, Redeye, Stinger, Roland, and HIVAD), and an electronic interface

Table 39

Current Status of PSF Development

MPT[2] TASK TAXONOMY		TIME	ACCURACY	TRAINING FREQUENCY & RECENCY
1.1	Visual Recognition/Discrimination	Data not available	PSF developed	Included in PSF
2.1	Numerical Analysis	PSF developed	PSF developed	Included in PSF
2.2	Information Processing/Problem Solving	PSF developed	PSF developed	Included in PSF
3.1.1	Fine Motor - Discrete	PSF developed	PSF developed	Included in PSF
3.1.2	Fine Motor - Continuous	Not enough tasks in Project A to develop PSF	Not enough tasks in Project A to develop PSF	Not enough tasks in Project A to develop PSF
3.2.1	Gross Motor - Heavy	Covered in Material Handling Models	Covered in Material Handling Models	Covered in Material Handling Models
3.2.2	Gross Motor - Light	Data not available	PSF developed	Included in PSF
4.1	Communication - Reading and Writing	PSF developed	PSF developed but weak	Included in PSF
4.2	Communication - Oral	PSF developed	PSF developed	Data not available - not included in PSF

which connects the weapon to sophisticated data collection and communication systems. Performance measures which RADES can assess include times and ranges for critical engagement events, aircraft identification accuracy, and kill or miss data.

Other simulators which could provide data for PER-SEVAL performance shaping functions include the Crew Station R&D Facility currently under development by the Army Aeroflight Dynamics Directorate and the AMC ARTI program and the developmental SIMNET (SIMNET-D) system at Fort Knox. The September/October 1988 MANPRINT Bulletin described how SIMNET-D could be used to support MANPRINT efforts.

Collection of empirical data from the simulators will be a time consuming process. However, the PER-SEVAL provides a "theoretical" framework which will allow this data to be generalized to a wide range of future systems and tasks -- thus the payoff will be high.

Within recent years, there has been renewed academic interest in examining the factors which moderate or impact the relationship between human abilities and task performance. For example, in recent years there have been several studies on the relationship between human abilities and skill acquisition (see, for example, Ackerman, 1987; Adams, 1987; Henry & Hulin, 1987; Schmidt, Hunter Outerbridge, Goff, 1988 and Ortega, 1989). These studies indicate that the relationship between performance and ability varies as function of type of ability, place in the skill acquisition process, and level of task difficulty. Almost all of these studies used ability measures that are not used by the Army. Thus, it is difficult to generalize their findings to Army personnel. One possible activity under the proposed task order would be to replicate selected academic studies using Army ability measures (e.g., ASVAB, Project A predictors). Results from such studies could lead to more accurate predictions of soldier performance.

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Appendix A

Project A Tasks, Taxons, Weights, and Descriptions

MOS: 11B

CODE	Function/Subfunction	TYPE	Prim. Taxon	W1	Sec'y Taxon	W2	Tert. Taxon	W3	Scale	ACCURACY Mean	ACCURACY S.D.	ACCURACY N	TIME Mean	TIME S.D.	TIME N	FREQUENCY Mean	FREQUENCY S.D.	FREQUENCY N	RECENCY Mean	RECENCY S.D.	RECENCY N	OTHER Name	OTHER Mean	OTHER S.D.	OTHER N
PROA	Prepare DRAGON for Firing	GoT	3.1.1	100						80.03	20.39	686	93.16	51.96	621	2.73	1.41	687	2.69	1.39	679				
PROB	Prepare M60 Range Card	GoT	2.1	60	4.1	20				69.08	22.97	677				2.9	1.65	692	2.59	1.35	687				
PROC	Engage Target w/ LAW	GoT	3.1.2	80	1.1	20				61.60	21.72	665				2.53	1.27	691	3.01	1.24	683				
PSD3	Engage Enemy Target with Hand Grenades	GoT	3.2.2	80	3.1.1	20			3.2.2	61.91	22.67	683				2.9	1.33	694	2.64	1.25	689				
PUB4	Operate Radio Set AN/PRC-77 - Compact Operations for AN/PRC-25 (AN/GRC-160 or AN/GRC-125))	GoT	3.1.1	100						95.27	13.04	677				3.59	1.35	692	1.96	1.11	690				
PUC3	Conduct Day and Night Surveillance Without Aid of Electronic Devices (Total Score (TS) measure)	GoT	1.1	100					1.1	74.07	30.40	658				2.87	1.46	691	2.6	1.37	688				
FRJ1	Tech. of Urban Terr. Movement	GoT	3.2.2	100					3.2.2	73.98	22.01	681				2.51	1.32	691	3.	1.29	686				
FUL3	Zero an AN/PVS-4 to an M16A1 Rifle	GoT	3.1.2	60	3.1.1	20	1.1	20		45.56	20.22	630				1.9	1.15	691	3.51	1.4	677				
IAA4	Put On Field Or Pressure Dressing	GoT	3.1.4	100						73.34	22.03	687				2.97	1.19	692	2.15	1.07	691				
IBB4	Perform Operator Maintenance On an M16A1 Rifle, Magazine, and Ammunition	GoT	3.1.1	100						91.05	10.5	685				1.65	0.81	693	4.28	1.09	692				
IBB5	Load, Reduce a Stoppage, and Clear an M60 Machinegun	GoT	3.1.1	100						82.9	18.9	680				3.45	1.30	693	2.06	1.11	690				
IBB6	Set Headspace/Timing on M2	GoT	3.1.4	100						61.6	62.68	679				2.56	1.45	693	2.84	1.59	688				
IBD1	Put On, Wear, Remove M17 Protective Mask With Hood	GoT	3.1.1	100						89.55	17.73	663	87.17	34.57	654	3.80	1.16	696	1.47	0.78	690				
IBI1	Install/Fire M18A1	GoT	3.1.1	100						64.49	20.5	679				2.62	1.24	691	2.63	1.20	688				
IEC3	ID Armored Vehicles (PC task)	Know	1.1	100					1.1	87.36	13.6	691													

Appendix A (continued)
Project A Tasks, Taxons, Weights, and Descriptions

MOS: 13M

			Prim.		Sec'y		Test			ACCURACY			TIME			FREQUENCY			RECENCY				OTHER		
CODE	Function/Subfunction	TYPE	Taxon	W1	Taxon	W2	Taxon	W3	Scale	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Name	Mean	S.D.	N
0012	Use Visual Signals to Control Movement (Mounted)	HoT	3.1.1	100						51.7	24.13	643				3.44	1.54	648	1.94	1.32	637				
0013	Replace/Recover Collimator (M102-0013, M198-0013)	HoT	3.1.1	90	1.1	5	3.1.2	5		90.55	11.67	618	104.12	27.1	581	3.48	1.46	647	2.11	1.24	634	T2	46.74	17.5	596
0014	Replace/Recover Aiming Post	HoT	3.1.1	100						90.93	15.2	629	91.62	24.22	618	3.20	1.47	643	2.23	1.29	635	T2	45.36	34.96	581
0015	Boresight Direct Fire Telescope Using DAP (Distant Aiming Point, M102-0010, M109-0015, M110-0018, M198-0018)	HoT	3.1.1	80	1.1	20				25.16	31.18	327	270.13	646.17	159	1.94	1.24	631	3.47	1.56	625				
0016	Sight on a Target With Direct Fire Telescope (M102-0017, M109-0016, M110-0019, M198-0018)	HoT	3.1.1	80	1.1	20				37.1	34.69	326	27.49	66.54	203	2.06	1.29	645	3.35	1.57	634				
0017	Lay Howitzer for Initial Direction of Fire (M109 Series-0011, M198-0017)	HoT	2.1	60	3.1.1	30	1.1	10		45.61	42.56	552	52.16	76.63	336	2.33	1.52	630	3.23	1.61	629				
0031	Disassemble/Assemble Breech Mechanism (M102-0038, M109-0031, M110-0034, M198-0036) (Frequency and Recency for M031 only)	HoT	3.1.1	100						53.79	42.4	258	596.94	386.79	189	2.82	1.45	641	2.49	1.46	630	T2	618.53	240.66	175
11A2	Perform Cardiopulmonary Resuscitation (CPR) on an Adult Using the One-Man Method	HoT	3.1.1	60	2.2	40				28.41	33.26	634	67.1	527.04	388	2.33	1.00	652	2.5	1.34	642	T2	160.72	552.79	275
11A3	Administer Nerve Agent Antidote to Self (Self-Aid)	HoT	3.1.1	100						86.88	18.81	623	39.98	31.53	598	2.62	1.18	650	2.22	1.25	640				
1203	Load, Clear M16A1 Rifle	HoT	3.1.1	100						86.13	15.42	639	15.55	56.96	622	3.08	1.27	652	1.91	1.03	640				
1206	Set Headspace/Timing on .50	HoT	3.1.1	100						55.4	42.4	605				2.65	1.38	652	2.6	1.41	644				
1207	Op. Maint. on .50 Machinegun	HoT	3.1.1	100						52.49	43.15	607	320.2	234.11	249	2.5	1.39	646	2.72	1.52	643				
10C4	Determine an Azimuth Using an M2 Compass	HoT	2.1	50	3.1.2	30	1.4	10		65.	19.24	645	40.84	62.89	643	3.33	1.33	652	1.93	1.08	640	T2	28.65	17.7	642
																						T3	28.03	18.6	634
10C5	Measure an Azimuth on a Map with a Protractor	HoT	2.1	80	4.1	20				37.28	40.15	634				2.59	1.21	651	2.36	1.33	638				
1301	Put On, Wear, Remove M17 Protective Mask with Hood	HoT	3.1.1	100						83.53	18.6	600	16.63	7.14	594	3.67	1.15	651	1.52	0.79	645				
1303	Put On Protective Clothing	HoT	3.1.1	100						77.58	20.71	638	267.36	95.10	620	3.29	1.16	649	1.62	0.8	639				
1333	Install and Operate a Field Telephone	HoT	3.1.1	100						77.68	19.32	646	103.2	96.94	541	3.25	1.4	648	2.07	1.2	637				

Appendix A (continued)
Project A Tasks, Taxons, Weights, and Descriptions

MOS: 19E

Code	Function/Subfunction	TYPE	Prim Taxon	W1	Sec'y Taxon	W2	Tert Taxon	W3	Scale	ACCURACY Mean	ACCURACY S.D.	ACCURACY N	TIME Mean	TIME S.D.	TIME N	FREQUENCY Mean	FREQUENCY S.D.	FREQUENCY N	RECENCY Mean	RECENCY S.D.	RECENCY N	Name	OTHER Mean	OTHER S.D.	OTHER N
[illegible]	Perf O.M. M3A1 Submachinegun	HoT	3.1.1	100					3.1.1	94.76	0.53	486	85.86	50.22	485	2.94	1.35	495	2.15	1.24	489	T2	202.56	100.06	484
[illegible]	Put On M25A1 Protective Mask With Hood	HoT	3.1.2	100						75.25	13.98	457	39.50	20.65	455	3.52	1.32	494	1.77	1.94	485				
[illegible]	Use an Automated CB01	HoT	4.2	80	2.2	20			4.2	68.88	28.6	487	200.13	90.	368	2.48	1.01	495	2.71	1.55	489				
[illegible]	Operate Radio Set AN/VRC-64 or AN/GRC-160 (AN/VRC-53 or AN/GRC-125)	HoT	3.1.1	100					3.1.1	84.22	16.92	487	113.85	88.85	458	3.62	1.2	490	1.76	1.07	485				
[illegible]	Start/Stop Tank Engine (on an M60A3/M60)	HoT	3.1.1	100					3.1.1	68.63	20.85	483				4.21	1.34	490	1.57	1.08	486				
[illegible]	Remove/Install Track Blocks	HoT	3.1.1	100					3.1.1	77.55	21.53	487	127.65	61.9	487	3.36	1.49	493	2.24	1.28	489				
[illegible]	Operate Gas Particulate Filter Unit (on an M60-Series	HoT	3.1.1	100					3.1.1	78.17	19.33	476	30.41	15.63	460	2.93	1.33	492	2.1	1.23	488				
[illegible]	Escape from Tank (on M60A3/M60-Series Tank)	HoT	3.3.2	100						79.94	18.46	476	38.68	19.86	464	1.72	0.89	492	3.22	1.59	486				
[illegible]	Boresight M60A3 Tank	HoT	3.1.1	80	1.1	20				64.77	17.12	418				2.66	1.07	489	2.78	1.46	489				
[illegible]	Perform Operator Maintenance on an M240 Machinegun	HoT	3.1.1	100					3.1.1	96.19	5.35	480	64.78	26.48	486	3.35	1.4	492	1.96	1.13	487	T2	78.43	30.76	486
[illegible]	Prepare Loader's Station for Operation (on an M60A3/M60-Series Tank)	HoT	3.1.1	100					3.1.1	98.01	8.63	400	137.37	63.93	397	2.93	1.39	488	2.31	1.26	484				
[illegible]	Perform Gunner's and Loader's Prepare-to-Fire Checks (LRF Self-Test) (on an M60A3 Tank)	HoT	1.1.1	100					3.1.4	87.42	23.1	350	111.65	160.13	332	2.81	1.52	489	2.62	1.47	487				
[illegible]	Put On Field or Pressure Dressing	HoT	3.3.1	100					3.3.1	82.63	17.79	487				2.61	1.16	494	2.23	1.24	491				
[illegible]	Determine Grid Coordinates of a Point on a Military Map Using the Military Grid Reference System	HoT	2.1	80	1.1	20				86.82	17.46	480	36.53	20.79	486	3.16	1.23	493	1.83	1.05	492				
[illegible]	Send a Radio Message	HoT	4.2	80	4.5	20			4.2	65.35	34.69	486				3.0	1.32	493	1.60	0.95	490				

Appendix A (continued)
Project A Tasks, Taxons, Weights, and Descriptions

MOS: 31C

CODE	Function/Subfunction	TYPE	Prim. Taxon	#1	Sec'y Taxon	#2	Tert. Taxon	#3	Scale	ACCURACY Mean	ACCURACY S.D.	ACCURACY N	TIME Mean	TIME S.D.	TIME N	FREQUENCY Mean	FREQUENCY S.D.	FREQUENCY N	RECENCY Mean	RECENCY S.D.	RECENCY N	Name	OTHER Mean	OTHER S.D.	OTHER N
C812	Troubleshoot GRC-142 (PC task)	Know	2.2	70	4.1	30			2.2	52.83	21.53	354													
C816	Troubleshoot GRC-106 (PC task)	Know	2.2	70	4.1	30			2.2	62.42	21.05	336													
C832	Operate in Radio Nets (PC task)	Know	2.2	70	4.1	30			2.2	56.27	22.43	340													
C801	Perform PMCS on Cargo Truck (M1028) (1-1/4 Ton, with Communication Shelter S1023)	HoT	3.1.1	60	4.1	40				65.66	18.17	335				3.71	1.72	356	2.08	1.6	351				
C802	Operate Generator PU-620	HoT	3.1.1	60	4.1	40				66.23	19.25	351	606.45	390.25	344	3.73	1.58	355	2.03	1.44	356				
C803	Perform Operator's Troubleshooting Procedures on Generator Set (PU-620)	HoT	2.2	80	4.1	20			2.2	80.15	15.47	343				3.19	1.55	346	2.21	1.43	347				
C818	Install Radio Teletypewriter Set AN/GRC-142 or AN/GRC-122	HoT	3.1.1	100						75.86	16.57	336	215.87	211.94	313	3.06	1.58	356	2.41	1.49	358				
C811	Op. Teletypewriter AN/GRC-142	HoT	2.2	60	1.4.1	20	4.1	20	2.2	72.65	22.35	331	809.15	291.8	289	3.33	1.58	353	2.85	1.32	351				
C813	Operate Terminal Communications AN/UGC-74A	HoT	3.1.1	60	4.1	20	3.1.1	20		70.94	15.48	267	1069.29	658.51	238	3.27	1.7	354	2.54	1.5	355				
C817	Install Radio Set AN/GRC-106	HoT	3.1.1	100						65.61	12.91	360	441.33	173.85	303	3.33	1.44	357	2.07	1.20	358				
C831	Estab/Enter/Leave Radio Net (includes Time exposure, TTI)	HoT	4.2	80	4.1	20			2.2	62.22	25.56	339	315.96	194.4	331	3.71	1.48	354	1.96	1.21	356				
C833	Use the KTC 1400 D Numerical Cipher/Authentication System	HoT	2.2	90	4.3	25			2.2	59.85	18.58	340	192.59	106.47	320	3.17	1.49	356	2.35	1.33	356				
C834	Prepare a Message in 15-Line Format	HoT	2.2	55	4.1	45			2.2	67.96	19.2	347	337.37	147.92	310	3.16	1.47	353	2.04	1.21	357				
C836	Recognize Electronic Countermeasures (ECM) and Implement Electronic Counter-Countermeasures (ECCM)	HoT	3.1.1	70	4.2	30				56.19	20.96	343	220.75	128.86	318	2.10	1.10	354	3.11	1.30	353				
181E	Put on Field or Pressure Dressing	HoT	3.1.3	100						72.25	21.55	352	51.37	45.31	347	2.80	1.27	349	2.29	1.2	351	72	41.36	68.55	332
1083	Load, Reduce a Stoppage, and Clear an M16A1 Rifle	HoT	3.1.1	100						84.52	15.08	351	21.82	20.05	340	3.10	1.35	350	2.01	1.09	357				
1AC2	Determine Grid Coordinates of a Point on a Military Map Using the Military Grid Reference System	HoT	2.3	80	4.1	20				63.67	26.92	340	51.73	24.83	319	3.22	1.26	356	2.05	1.1	357				
1MD3	Put on Protective Clothing	HoT	3.1.1	100						74.7	22.78	349				3.37	1.1	358	1.07	1.03	357				

Appendix A (continued)
Project A Tasks, Taxons, Weights, and Descriptions

MOS: 63B

CLAS	Function/Subfunction	TYPE	Prim. Taxon	%1	Sec'y Taxon	%2	Tert Taxon	%3	Scale	Accuracy Mean	Accuracy S.D.	Accuracy N	Time Mean	Time S.D.	Time N	Frequency Mean	Frequency S.D.	Frequency N	Recency Mean	Recency S.D.	Recency N	Name	Other Mean	Other S.D.	Other N
[illegible]	Replace Wheel Bearings (Truck, Cargo, 2 1/2-Ton, 6 x 6)	HoT	3.1.1	80	4.1	20				88.38	17.34	590	614.46	266.9	597	3.67	1.37	619	1.98	1.17	614				
[illegible]	Maintain Assigned Toolkit	HoT	3.1.1	80	4.1	20				43.25	19.39	583	232.45	160.62	526	4.11	1.23	617	1.56	1.04	617				
[illegible]	Troubleshoot Electrical System (Truck, Cargo, 5-Ton, 6 x 6)	HoT	2.2	80	3.1.1	10	4.1	10		83.56	12.83	578	581.52	485.31	564	2.33	1.37	611	2.07	1.51	613				
[illegible]	Repair Electrical Wiring (Truck, Cargo, 1 1/4-Ton, 6 x 6)	HoT	3.1.1	100						91.67	17.4	583	272.11	64.82	564	2.52	1.35	618	2.82	1.53	612				
[illegible]	Adjust Clutch Pedal Free Travel (Truck, Utility, 1/4-Ton, 4 x 4)	HoT	3.1.3	80	4.1	20				86.34	19.69	582	538.25	250.21	548	2.83	1.36	520	2.51	1.35	615				
[illegible]	Replace Service Brakes (Truck, Utility, 1/4-Ton, 4 x 4)	HoT	3.1.1	80	4.1	20				87.35	19.79	576	957.2	368.89	572	2.61	1.33	617	2.01	1.41	613				
[illegible]	Replace Air Hydraulic Cylinder (Truck, Cargo, 2 1/2-Ton, 6 x 6)	HoT	3.1.1	80	4.1	20				94.44	14.79	585	683.17	225.61	582	3.8	1.31	618	2.39	1.29	612				
[illegible]	Troubleshoot Service Brake Malfunctions (Truck, Utility, 1/4-Ton, 4 x 4)	HoT	2.2	80	3.1.1	10	4.1	10		83.12	21.57	539	530.21	287.37	538	2.56	1.31	616	2.8	1.42	610				
[illegible]	Replace Fuel Pump (Truck, Cargo, 2 1/2-ton, 6 x 6)	HoT	3.1.1	80	4.1	20				95.20	9.26	594				2.01	1.05	616	3.28	1.45	608				
[illegible]	Troubleshoot Fuel System Malfunctions (Truck, Cargo, 2 1/2-Ton, 6 x 6)	HoT	2.2	80	3.1.5	10	4.1	10		80.12	22.30	568	712.56	304.35	566	2.37	1.16	619	2.84	1.44	608				
[illegible]	Put On Field or Pressure Dressing	HoT	3.1.1	100						78.42	19.9	615	56.95	45.74	579	2.91	1.25	618	2.5	1.3	616	T2	53.69	49.95	552
[illegible]	Load, Reduce a Stoppage, and Clear an M16A1 Rifle	HoT	3.1.1	100						89.31	13.37	582	12.32	11.18	587	3.2	1.31	617	2.18	1.13	613				
[illegible]	Determine a Magnetic Azimuth Using a Compass	HoT	2.1	80	4.1	20				73.28	23.60	604	76.42	62.88	577	2.78	1.2	618	[illegible]	1.2	618				
[illegible]	Put On, Wear, Remove M17 Protective Mask With Hood	HoT	3.1.1	100						87.53	17.34	571	13.67	57.04	563	3.5	1.25	600	1.80	0.95	605	T2	5.55	27.20	562
[illegible]	Use Challenge and Password	HoT	4.2	100						88.41	18.40	596	104.19	117.60	551	3.24	1.12	620	2.24	1.17	617				

Appendix A (continued)
Project A Tasks, Taxons, Weights, and Descriptions

MOS: 64C

CODE	Function/Subfunction	TYPE	Prim. Taxon	W1	Sec'y Taxon	W2	Tert. Taxon	W3	Scale	ACCURACY Mean	ACCURACY S.D.	ACCURACY N	TIME Mean	TIME S.D.	TIME N	FREQUENCY Mean	FREQUENCY S.D.	FREQUENCY N	RECENCY Mean	RECENCY S.D.	RECENCY N	OTHER Name	OTHER Mean	OTHER S.D.	OTHER N
C005	Decontaminate Equip ABC-M11	HoT	3.1.1	100						88.99	15.51	550													
C036	Use M8 Paper to Identify a Chemical Agent	HoT	1.1	60	3.1.1	40				88.4	17.38	550	48.93	56.21	616										
C003	Couple Semitrailer	HoT	3.1.1	100						85.11	14.65	422				3.15	1.64	675	2.66	1.48	668				
C001	Uncouple Semitrailer	HoT	3.1.1	100						87.80	18.32	413				3.15	1.60	672	2.65	1.47	667				
C005	Operate Tractor and Semitrailer	HoT	3.1.1	100						68.77	19.18	515				3.19	1.67	675	2.65	1.49	667				
1041	Administer First Aid to Nerve Agent Casualty (Buddy Aid)	HoT	3.1.1	100						76.42	22.61	630				2.02	1.02	676	2.99	1.42	671				
1042	Perform Cardiopulmonary Resuscitation (CPR) on an Adult Using the One-Man Method	HoT	3.1.1	60	3.2	40				64.95	32.13	560	23.23	64.14	284	1.01	0.9	678	3.11	1.44	675	92	116.35	153.59	280
1043	Administer Nerve Agent Antidote	HoT	3.1.1	100						83.4	17.42	671	27.49	12.54	643	2.36	1.80	597	2.52	1.24	674				
1046	Put On Field or Pressure Dressing	HoT	3.1.3	100						77.16	18.24	471				2.52	1.1	679	2.45	1.15	673				
1003	Load, Reduce a Stoppage, and Clear an M16A1 Rifle	HoT	3.1.1	100						86.37	15.19	655	112.45	283.91	581	2.98	1.26	680	2.07	1.12	677				
1004	Perform Operator Maintenance On an M16A1 Rifle, Magazine, and Ammunition	HoT	3.1.1	100						83.85	14.78	647				3.26	1.22	673	1.82	0.96	668				
1005	Load, Reduce a Stoppage and Clear an M60 Machinegun	HoT	3.1.1	100						59.56	22.43	600				1.47	1.14	672	3.46	1.5	668				
2062	Determine Grid Coordinates of a Point on a Military Map Using the Military Grid Reference System	HoT	2.1	60	6.1	30				62.06	33.76	622	56.66	30.41	603	2.65	1.11	678	2.33	1.14	670				
2063	Measure Distance on a Map	HoT	2.1	70	6.1	30				69.09	26.94	605				2.10	1.00	676	2.83	1.43	670				
3001	Put On, Wear, Remove M17 Protective Mask With Hood	HoT	3.1.3	100						90.88	14.07	552	33.02	134.66	650	3.25	1.19	680	1.8	0.96	675				
3003	Put on and Wear Protective Clothing	HoT	3.1.1	100						77.43	19.31	553	413.96	115.3	633	2.91	1.17	679	2.01	1.02	674				

Appendix A (continued)
Project A Tasks, Taxons, Weights, and Descriptions

MOS: 71L

CODE	Function/Subfunction	TYPE	Prim. Taxon	#1	Sec's Taxon	#2	Tert Taxon	#3	Scale	ACCURACY Mean	ACCURACY S.D.	ACCURACY N	TIME Mean	TIME S.D.	TIME N	FREQUENCY Mean	FREQUENCY S.D.	FREQUENCY N	RECENCY Mean	RECENCY S.D.	RECENCY N	OTHER Name	OTHER Mean	OTHER S.D.	OTHER N
A001	File Documents/Correspondence	HoT	4.1	70	3.2	30			4.1	62.99	19.65	495	651.20	306.95	435	4.03	1.53	507	1.76	1.29	506				
A003	Prepare a Requisition for Publications/Blankforms using AUTODIN (DA Form [illegible])	HoT	4.1	100					4.1	66.12	30.07	485	683.43	258.96	437	2.22	1.46	505	3.25	1.53	501				
A032	Type Military Orders	HoT	3.1.7	80	4.1	20				67.03	25.8	499	534.06	623.5	112	1.77	1.39	506	3.09	1.36	502				
A033	Type a Second or Subsequent Comment to a Disposition Form	HoT	3.1.1	68	4.1	33				39.85	13.64	499	365.34	270.60	320	3.15	1.66	508	2.25	1.44	506				
A034	Type a Joint Message Form (DD Form 173/1)	HoT	3.1.1	80	4.1	20				51.23	37.5	496	920.88	655.35	163	2.04	1.43	507	3.22	1.48	503				
A035	Type Straight Copy Material (Total Score (TS) only)	HoT	3.1.1	70	4.1	30				37.8	12.27	503				3.19	1.65	501	2.33	1.54	499				
A036	Type a Memorandum	HoT	3.1.1	80	4.1	20				71.95	10.07	500	650.05	267.72	368	2.43	1.45	507	2.01	1.51	505				
A037	Type a Basic Comment to a Disposition Form	HoT	3.1.1	66	4.1	34				76.14	15.51	498	796.33	380.37	315	1.67	1.59	508	1.88	1.33	507				
A039	Type a Military Letter	HoT	3.1.1	80	4.1	20				65.34	18.37	496	634.37	812.1	889	3.65	1.56	503	1.92	1.29	507				
A082	Receipt/Transfer Classified Info.	HoT	4.1	60	3.1.1	40			4.1	26.52	25.39	490	692.63	630.7	624	1.7	1.31	500	3.92	1.40	501				
1161	Put On Field or Pressure Dressing	HoT	3.1.1	100						63.37	25.81	505	71.32	51.59	493	2.4	1.13	500	2.67	1.25	497	T2	51.01	104.02	458
1301	Perform Operator Maintenance On an M16A1 Rifle Magazine, and Ammunition	HoT	3.1.1	100						74.82	18.07	485	187.60	65.51	484	2.93	1.24	502	2.2	1.15	499	T2	261.6	100.82	475
1302	Determine Grid Coordinates of a Point on a Military Map Using the Military Grid Reference System	HoT	2.1	80	4.1	20				60.13	30.92	505	100.81	63.73	554	2.63	1.15	506	2.4	1.19	503	T2	59.66	33.86	435
2001	Put On, Wear, Remove M17 Protective Mask With Hood	HoT	3.1.1	100						85.9	19.05	635				2.92	1.22	505				T2	9.70	40.85	465
A004	Establish Functional Files (PC task)	Know	4.1	100					4.1	54.99	24.51	506													
A031	Dispatch Outgoing Dist (PC task)	Know	4.1	100					4.1	39.98	17.19	508													
A033	Type 2nd Comment to Disposition Form (PC task) (Taxon measure uses Frequency, Recency, and Time values from A033)	Know	4.1	100					4.1	67.99	26.79	500													
A034	Type Jt. Message Form (PC task) (Taxon measure uses Frequency, Recency, and Time values from A034)	Know	4.1	100					4.1	68.37	23.83	506													
A037	Type a Basic Comment to Disposition Form (PC task) (Taxon measure uses Frequency, Recency, and Time values from A037)	Know	4.1	100					4.1	63.84	29.09	507													
A038	Assemble Correspondence (PC task)	Know	4.1	100					4.1	40.63	27.31	507													
A039	Type Military Letter (PC task) (Taxon measure uses Frequency, Recency, and Time values from A039)	Know	4.1	100					4.1	52.05	21.8	501													

Appendix A (continued)
Project A Tasks, Taxons, Weights, and Descriptions

MOS: 91A

Code	Function/Subfunction	TYPE	Prim. Taxon	W1	Sec'y Taxon	W2	Tert. Taxon	W3	Scale	ACCURACY Mean	ACCURACY S.D.	ACCURACY N	TIME Mean	TIME S.D.	TIME N	FREQUENCY Mean	FREQUENCY S.D.	FREQUENCY N	RECENCY Mean	RECENCY S.D.	RECENCY N	Name	OTHER Mean	OTHER S.D.	OTHER N
1HA8	Splint a Suspected Fracture	EoT	3.1.1	100						76.56	17.07	496	283.13	186.88	439	2.39	1.3	493	3.01	1.38	495				
1HA6	Open the Airway	HoT	3.1.1	100						74.03	23.89	496				2.72	1.44	489	2.05	1.38	492				
1HA9	Initiate a Field Medical Card	HoT	4.1	100						72.72	15.4	496	386.63	145.31	426	2.48	1.38	491	2.96	1.37	491				
181A	Assemble Needle and Syringe (Vial)	HoT	3.1.1	100						71.58	19.3	127													
181B	Administer an Injection (Vial)	HoT	3.1.1	100						76.24	23.25	127													
181C	Initiate an Intravenous Infusion	HoT	3.1.1	100						65.3	24.29	494				2.48	1.38	493	3.05	1.3	491				
1813	Measure and Record a Patient's Pulse	HoT	3.1.1	100						75.35	17.87	496				4.24	1.25	496	1.78	1.07	492				
1814	Measure and Record a Patient's Respiration	HoT	3.1.1	70	2.1	30				68.87	19.92	496				4.15	1.34	494	1.85	1.13	491				
1815	Measure and Record a Patient's Bloodpressure	HoT	3.1.1	70	2.1	30				85.22	12.27	496				4.3	1.21	496	1.74	1.04	493				
1816	Assemble Needle and Syringe (Ampule)	HoT	3.1.1	100						75.84	16.55	369				3.21	1.61	495	2.73	1.34	493				
1817	Change Dressing	HoT	3.1.1	100						52.42	22.69	496				2.84	1.51	494	2.7	1.41	490				
1818	Administer an Injection (Ampule)	HoT	3.1.1	100						74.65	19.23	369				3.25	1.62	494	2.8	1.31	493				
1819	Maintain a Sterile Field & Change a Sterile Dressing	HoT	3.5.1	100						60.46	29.26	496				2.47	1.4	492	3.11	1.35	490				
1821	Decontaminate Thermometers	HoT	3.1.1	100						52.41	21.35	494				2.73	1.64	493	2.84	1.55	494				
1HA2	Perform Cardiopulmonary Resuscitation (CPR) on an Adult Using the One-Man Method	HoT	3.1.1	60	2.2	40				82.96	22.21	492	22.22	17.18	401	2.61	1.48	493	3.01	1.44	492	T2	143.03	183.13	417
1HA4	Put On a Field or Pressure Dressing	HoT	3.1.1	100						88.81	12.21	496	84.88	37.23	422	3.03	1.47	492	2.51	1.32	493	T2	48.55	28.71	424
[illegible]	Determine Grid Coordinates of a Point on a Military Map Using the Military Grid Reference System	HoT	2.1	80	4.1	20				69.72	23.90	496	81.7	44.4	470	3.23	1.36	495	2.25	1.17	493	T2	63.79	104.23	476

Appendix A (continued)
Project A Tasks, Taxons, Weights, and Descriptions

MOS: 95B

CODE	Function/Subfunction	TYPE	Prim. Taxon	W1	Sec'y Taxon	W2	Tert. Taxon	W3	Scale	ACCURACY Mean	ACCURACY S.D.	ACCURACY N	TIME Mean	TIME S.D.	TIME N	FREQUENCY Mean	FREQUENCY S.D.	FREQUENCY N	RECENCY Mean	RECENCY S.D.	RECENCY N	OTHER Name	OTHER Mean	OTHER S.D.	OTHER N
[illegible]	Prepare/Operate FM Radio Set	HoT	3.1.1	100						75.63	17.48	678	331.6	162.96	574	3.28	1.5	686	2.11	1.22	686				
[illegible]	Estimate Range	HoT	2.1	70	1.1	30			2.1	33.83	30.06	670				2.26	1.31	684	3.04	1.40	677				
[illegible]	Perform Operator/Crew Preventive Maintenance Checks and Services	HoT	3.1.1	70	1.1	30	2.2			76.26	15.19	671				4.4	1.12	680	1.42	0.9	684				
[illegible]	Prepare Military Police Reports and Forms	HoT	2.2	70	4.1	30				88.09	10.62	664	772.63	235.75	558	4.43	1.14	685	1.54	0.9	680				
[illegible]	Use Hand and Arm Signals to Direct Traffic	HoT	3.1.1	80	1.1	20				81.82	22.72	676				3.58	1.47	687	1.99	1.18	683				
[illegible]	Operate a Dismount Point	HoT	4.2	100	[illegible]					61.95	23.24	674				2.39	1.39	686	3.02	1.13	677				
[illegible]	Perform Cardiopulmonary Resuscitation (CPR) on an Adult Using the One-Man Method	HoT	3.1.1	60	2.2	40				72	20.61	682	25.69	24.15	542	2.09	1.2	685	3.21	1.39	680	T2	182.84	282.27	540
[illegible]	Put On Field or Pressure Dressing	HoT	3.1.1	100						74.12	20.61	682	68.9	34.11	533	2.42	1.21	687	2.7	1.32	681	T2	48.47	35.03	504
[illegible]	Operate and Maintain a .45 Caliber Pistol	HoT	3.1.1	100						87.25	10.66	623	11.89	9.7	621	4.36	1.13	688	1.45	0.86	684	T2	19.73	18.98	613
																						T3	42.32	23.30	619
																						T4	82.46	54.31	613
																						T5	13.04	13.31	602
[illegible]	Operate and Maintain a .38 Caliber Revolver	HoT	3.1.1	100						90.34	11.13	68	116.10	7.55	49							T2	12.64	15.66	58
[illegible]	Load, Reduce a Stoppage, and Clear an M16A1 Rifle	HoT	3.1.1	100						84.27	14.19	682	12.22	8.16	600	3.36	1.4	688	2.11	1.13	682				
[illegible]	Load, Reduce a Stoppage and Clear M60 Machinegun	HoT	3.1.1	100						83.63	20.01	678	37.07	23.53	661	2.89	1.48	687	2.6	1.3	681	T2	25.59	16.30	627
																						T3	29.88	26.47	659
[illegible]	Determine a Magnetic Azimuth Using a Compass	HoT	2.1	80	4.1	20			2.1	81.15	25.53	668	58.44	34.58	634	3.01	1.33	687	2.27	1.1	681				
[illegible]	Determine Grid Coordinates of a Point on a Military Map Using the Military Grid Reference System	HoT	2.1	80	4.1	20			2.1	84.28	16.41	674	65.82	182.67	660	3.25	1.28	685	1.96	0.59	680	T2	39.	28.83	627
[illegible]	Call For/Adjust Indirect Fire	HoT	2.1	90	4.2	10			2.1	19.65	16.73	656	57.69	44.71	636	1.62	0.86	686	3.79	1.2	673	T2	88.44	58.05	398
[illegible]	Navigate From One Point On the Ground To Another Point	HoT	2.1	80	4.1	20			2.1	66.71	24.15	664				2.62	1.32	683	2.68	1.31	675				
[illegible]	Put On, Wear, Remove M17 Protective Mask With Hood	HoT	3.1.1	100						85.6	17.25	661	8.72	2.56	651	3.62	1.89	686	1.83	0.91	682	T2	9.94	6.63	633

APPENDIX B. Personnel Characteristics in Project A Data Base

PROJECT A CODE	TITLE	INCLUDED AS PERSONNEL CHARACTERISTIC	REASON FOR EXCLUSION
A1AS80AR	New 1980 Stdz ASVAB Subtest - AR	No	Part of Area Composite
A1AS80AS	New 1980 Stdz ASVAB Subtest - AS	No	Part of Area Composite
A1AS80CS	New 1980 Stdz ASVAB Subtest - CS	No	Part of Area Composite
A1AS80EI	New 1980 Stdz ASVAB Subtest - EI	No	Part of Area Composite
A1AS80GS	New 1980 Stdz ASVAB Subtest - GS	No	Part of Area Composite
A1AS80MC	New 1980 Stdz ASVAB Subtest - MC	No	Part of Area Composite
A1AS80MK	New 1980 Stdz ASVAB Subtest - MK	No	Part of Area Composite
A1AS80NO	New 1980 Stdz ASVAB Subtest - NO	No	Part of Area Composite
A1AS80PC	New 1980 Stdz ASVAB Subtest - PC	No	Part of Area Composite
A1AS80VE	New 1980 Stdz ASVAB Subtest - VE	No	Part of Area Composite
A1AS80WK	New 1980 Stdz ASVAB Subtest - WK	No	Part of Area Composite
A1AC80CL	New 1980 Area Composite - CL <New>	Yes	
A1AC80CO	New 1980 Area Composite - CO	Yes	
A1AC80EL	New 1980 Area Composite - EL	Yes	
A1AC80FA	New 1980 Area Composite - FA	Yes	
A1AC80GM	New 1980 Area Composite - GM	Yes	
A1AC80GT	New 1980 Area Composite - GT	Yes	
A1AC80MM	New 1980 Area Composite - MM	Yes	
A1AC80OF	New 1980 Area Composite - OF	Yes	
A1AC80SC	New 1980 Area Composite - SC <New>	Yes	
A1AC80ST	New 1980 Area Composite - ST	Yes	
A1AFQT80	New 1980 AFQT Score	No	Redundant with Area Composite
A1MCAT80	New 1980 Mental Category	No	Redundant with Area Composite
A1WGT	Weight	No	Included in Material Handling Models
A1HGT	Height	No	Included in Material Handling Models
A1DIABLD	Diastolic Blood Pressure	No	Included in Material Handling Models
A1PULHE1	PULHES Factor - Physical Stamina	No	Lack of Variability
A1PULHE2	PULHES Factor - Upper Extremities	No	Lack of Variability
A1PULHE3	PULHES Factor - Lower Extremities	No	Lack of Variability
A1PULHE4	PULHES Factor - Hearing	No	Lack of Variability
A1PULHE5	PULHES Factor - Eyes	No	Lack of Variability
A1PULHE6	PULHES Factor - Psychiatric	No	Lack of Variability
A1PULHE7	PULHES Factor - Exp Weightlift	No	Only Available on 1/5 of Population
Accessions Constructs:			
A1AQUANT	ASVAB Construct: Quantitative	No	Redundant with Area Composite
A1ASPEED	ASVAB Construct: Speed	No	Redundant with Area Composite
A1ATECH	ASVAB Construct: Technical	No	Redundant with Area Composite
A1AVERBL	ASVAB Construct: Verbal	No	Redundant with Area Composite
Cognitive Tests:			
B3PSAONC	# CORR: Assembling Objects	No	Inc. in Composite Measures
B3PSMPNC	# CORR: Map Test	No	Inc. in Composite Measures
B3PSMZNC	# CORR: Maze Test	No	Inc. in Composite Measures
B3PSORNC	# CORR: Object Rotation	No	Inc. in Composite Measures
B3PSOTNC	# CORR: Orientation Test	No	Inc. in Composite Measures
B3PSRSNC	# CORR: Reasoning Test	No	Inc. in Composite Measures
Cognitive Constructs:			
B3PCORNT	Cognitive Sub-Construct: Spat. Orient.	No	Inc. in Composite Measures
B3PCREAS	Cognitive Sub-Construct: Spatial Reas.	No	Inc. in Composite Measures
B3PCSCAN	Cognitive Sub-Construct: Spatial Scan.	No	Inc. in Composite Measures
B3PCSPAT	Cognitive Construct: Overall Spatial	Yes	

APPENDIX B. Personnel Characteristics in Project A Data Base (Cont.)

PROJECT A CODE	TITLE	INCLUDED AS PERSONNEL CHARACTERISTIC	REASON FOR EXCLUSION
Choice Reaction Time:			
B3CSCRDT	CRT: Mean of Trimmed Decision Time	No	Inc. in Composite Measures
B3CSCRHT	CRT: Mean Hit Rate	No	Inc. in Composite Measures
Cannon Shoot:			
B3CSCSTS	CS: Mean Abs. Time Discrep	No	Inc. in Composite Measures
Number Memory:			
B3CSNMDT	NUM: Mean for Final Response	No	Inc. in Composite Measures
B3CSNMHT	NUM: Mean Hit Rate	No	Inc. in Composite Measures
B3CSNMIN	NUM: Mean for Initial Input	No	Inc. in Composite Measures
B3CSNMOP	NUM: Pooled Mean Operation Time	No	Inc. in Composite Measures
Perceptual Speed & Accuracy:			
B3CSPSDT	PSA: Mean of Trimmed Decision Time	No	Inc. in Composite Measures
B3CSPSHT	PSA: Mean Hit Rate	No	Inc. in Composite Measures
Short-Term Memory:			
B3CSSMDT	MEM: Mean of Trimmed Decision Time	No	Inc. in Composite Measures
B3CSSMHT	MEM: Mean Hit Rate	No	Inc. in Composite Measures
Simple Reaction Time:			
B3CSSRDT	SRT: Mean of Trimmed Decision Time	No	Inc. in Composite Measures
B3CSSRHT	SRT: Mean Hit Rate	No	Inc. in Composite Measures
Target Identification Test:			
B3CSTIDT	TARGET: Mean of Trimmed Decision Time	No	Inc. in Composite Measures
B3CSTIHT	TARGET: Mean Hit Rate	No	Inc. in Composite Measures
Target Shoot:			
B3CSTSDL	TARGET SHOOT - Mean Log (Dist + 1)	No	Inc. in Composite Measures
B3CSTSDT	TARGET SHOOT - Mean Time to Fire	No	Inc. in Composite Measures
Target Tracking 1:			
B3CST1DL	TARGET TRACKING 1 - Mean Log (Dist + 1)	No	Inc. in Composite Measures
Target Tracking 2:			
B3CST2DL	TARGET TRACKING 2 - Mean Log (Dist + 1)	No	Inc. in Composite Measures
Total Movement Time:			
B3CSRTMT	Pooled Mean Movement Time	No	Inc. in Composite Measures
Predictor Computer Constructs:			
B3CCCPAC	Computer Construct: Complex Perc Accy	Yes	-
B3CCCPSP	Computer Construct: Complex Perc Speed	Yes	-
B3CCNMSA	Computer Construct: Num Speed/Acc.	Yes	-
B3CCPSYM	Computer Construct: Psychomotor	Yes	-
B3CCSRAC	Computer Construct: Simp. React. Acc.	Yes	-
B3CCSRSP	Computer Construct: Simp. React. Speed	Yes	-

Appendix C: Task Taxonomy Taxon Descriptions

I Perceptual

1.1 Visual Pattern Recognition/Discrimination -- Using the eyes to identify or discriminate targets or objects.

Examples: Identify target; identify friend or foe, conduct day and night surveillance.

NOTE: Reading text or numbers is covered under a separate task type (see 4.1-READING/WRITING

II Cognitive

2.1 Numerical -- performing arithmetical or mathematical calculations.

Examples: Measure an azimuth on a map with a protractor, estimate range, determine weight and balance bearing.

2.2 Reasoning/Problem Solving/Decision Making -- encoding or decoding information; classifying objects into categories; troubleshooting or identifying the cause or source of an existing problem or failure; planning or developing a set of procedures for performing future actions; selecting the "best" course of action from a set of multiple alternatives.

Examples: Encode/decode messages. Plan flight. Troubleshoot fuel system malfunction. Troubleshoot electrical system malfunction. Select firing position.

NOTE: A task which involves simple reading comprehension should be categorized under READING/WRITING (4.1). A task which involves reading material and then performing the types of cognitive activities described above (e.g., encoding or decoding) should be categorized under both READING/WRITING and REASONING/PROBLEM SOLVING/DECISION MAKING.

NOTE: Do not assign a task to the REASONING/PROBLEM SOLVING/DECISION MAKING taxon simply because it has heavy memory requirements (e.g., has a lot of steps). Recalling things from memory is part of every taxon.

REASONING/PROBLEM SOLVING/DECISION MAKING should be used when the user is required to perform the types of cognitive activities described above (e.g., encoding or decoding) with the material which is recalled from memory.

III Motor

3.1 Fine Motor

3.1.1 Fine motor discrete. A task involving a set of discrete actions performed in a predetermined sequence. These actions largely involve movement of the hands, arms, or feet and require little physical effort.

Examples: Prepare a DRAGON for firing; Conduct engine shutdown; Assemble SAW; Put On, Wear, Remove M17 Protective Mask; Start and Stop a Tank Engine.

3.1.2 Fine motor - continuous. Continuously performing the actions needed to keep a system on a specified path (e.g., piloting, driving); aiming a gun, weapon or sensor at a target either by pointing the weapon directly or by moving a cursor or other control device; aligning two objects with one another by continuously moving one or more of the objects until they are properly aligned.

Examples: Drive vehicle; Land aircraft; Takeoff aircraft; Aim/sight rifle; Adjust rifle fire.

3.2 Gross Motor

3.2.1 Gross motor - heavy. Actions involving extensive physical effort or exertion.

3.2.1.1 Carrying/load bearing. Lifting an object, moving it from one point to another, and lowering it. Example: Load ammunition onto howitzer.

3.2.1.2 Lifting/lowering. Lifting and/or lowering an object and unloading or releasing it. Example: Load cannon.

3.2.1.3 Torquing/pulling. Using a wrench or other tool to tighten or loosen a screw, bolt, or other fastener. Example: Adjust tire lugs.

3.2.2 Gross motor light. Actions involving movement of the entire body which do not require extensive physical effort.

Examples: Evacuate tank. Get into firing position (for using an M16 rifle). Engage enemy target with hand grenade.

IV Communication

4.1 Reading/Writing -- Reading text or numbers off a hard-copy or CRT; writing with pen or pencil.

Example: Check vehicle record form; Prepare a requisition for publications.

NOTE: Typing tasks involve both READING/WRITING and FINE MOTOR DISCRETE.

NOTE: If the soldier must read a technical manual during performance of task, at least a part of the task should be assigned to the READING/WRITING category.

4.2 Oral Communication -- Talking or listening to another person.

4.2.1 Face-to-face communication. Talking or listening to another person who is physically present. Example: Issue Order; Use Challenge and Password.

4.2.2 Radio/telephone communication. Talking or listening to another person over a radio, intercom, or other electronic medium. Example: Transmit/receive messages; Call for indirect fire.

APPENDIX D

Variance/Covariance Matrices for MOSs Used in Regression Analyses

MOS 11B - Within Cells Variances and Covariances - Time and Accuracy
Visual Pattern Recognition/Discrimination
Gross Motor Light

	CL *	CO	BL	FA	GM	GT	MM	OF	SC	ST	CPAC
CL *	183.64657										
CO	132.87170	152.44014									
BL	170.98996	137.73115	186.16561								
FA	157.65777	145.15131	152.35839	169.54240							
GM	150.62897	140.44750	176.47294	133.06396	190.43895						
GT	170.51478	127.00617	158.50373	138.51952	141.38710	171.76924					
MM	108.10624	129.11246	131.31780	114.48884	146.94217	102.54831	145.10725				
OF	124.92002	131.65197	130.65664	120.08366	142.75817	122.46188	133.63321	141.33653			
SC	153.81561	150.49160	158.40519	139.54911	165.04112	153.44822	138.79647	147.64286	175.26494		
ST	173.27334	143.21302	180.66667	154.95133	178.35343	162.29521	134.62626	147.50041	171.26356	201.08683	
CPAC	76.58466	69.92916	71.73774	76.25265	64.29198	73.42623	48.95716	56.10939	70.23145	74.87228	430.35768
CPSP	35.08959	52.33386	39.53659	51.25008	41.47423	30.97022	46.64517	49.84733	41.11725	47.67657	-124.41149
SRSP	16.39540	14.88468	13.86367	21.96179	8.26219	12.39740	11.35229	14.32079	8.73834	15.25938	-7.73550
SRAC	30.32781	31.67426	38.33154	29.83347	39.30234	28.81656	29.97413	28.39350	36.47380	39.89488	55.77347
SPAT	334.90571	333.06918	330.98999	363.89538	301.60713	305.73753	265.39856	280.07109	329.54915	352.50294	294.33094
RDGLVL	20.98313	15.65599	19.48235	17.07585	17.37011	21.12767	12.63639	15.10107	18.89190	19.96377	8.95092
PREQ1	1.11201	.59777	.96643	.22939	1.37178	1.23346	1.02964	1.44699	1.80409	1.80355	-1.04032
REC1	-1.36846	-1.15307	-1.15686	-.74282	-1.41496	-1.63080	-.90635	-1.32975	-1.87389	-1.64299	-.24488
PRE_REC1	-1.24523	-1.82560	-.88106	-2.27209	-.47690	-.99860	-.20394	-.20273	-.30657	-.19368	-5.15697
TAXON1	2.49230	2.32502	2.74686	2.42543	2.72385	2.29874	2.18008	2.29035	2.57254	2.93353	2.92884
PREQ7	-1.82828	-1.89356	-2.24715	-1.66766	-2.41389	-1.96600	-1.82273	-1.76278	-1.93424	-2.06010	-.73085
REC7	.74689	.69673	.87466	.49253	1.02452	.82769	.72831	.79815	.92844	.84689	-1.13418
PRE_REC7	-2.99194	-3.28063	-3.61261	-3.21743	-3.45177	-3.29573	-2.81475	-2.34561	-2.58579	-2.68832	-5.04515
TAXON7	1.04887	1.12437	1.04066	1.05229	1.26678	.90544	.96682	1.18644	1.17996	1.37070	.79759

	CPSP	SRSP	SRAC	SPAT	RDGLVL	PREQ1	REC1	PRE_REC1	TAXON1	PREQ7	REC7
CPSP	482.70804										
SRSP	124.20694	330.37709									
SRAC	14.05406	27.46727	247.65530								
SPAT	308.71227	124.29382	139.22107	2083.16460							
RDGLVL	3.74854	1.56408	3.64390	37.49829	2.61523						
PREQ1	1.11641	1.77241	-.21090	3.08012	.14881	2.09572					
REC1	.23445	-.39757	-.55648	-2.51305	-.19317	-1.25279	1.82753				

	CPSP	SRSP	SRAC	SPAT	RDGLVL	PREQ1	REC1	PRE_REC1	TAXON1	PREQ7	REC7
PRE_REC1	3.42615	4.23829	-1.95178	-3.33345	-.10489	2.26354	.56153	10.32017			
TAXON1	1.23424	.17420	.82142	8.54585	.28589	-.01458	.01655	-.02082	.55945		
PREQ7	1.12444	.32679	-.58089	-.57591	-.24104	.56644	-.23368	1.03573	-.06849	1.24840	
REC7	-.18405	.28569	-.00304	-2.81369	.09897	-.12279	.20023	.29723	.03958	-.49497	1.02763
PRE_REC7	4.21664	1.03963	-2.01292	-7.44697	-.41024	1.31727	.04065	4.17131	-.05440	2.31474	1.11539
TAXON7	1.88843	1.69218	.56168	3.88866	.18462	.10850	-.09128	.07402	.07571	.01180	-.03221

	PRE_REC7	TAXON7
PRE_REC7	10.61836	
TAXON7	-.03257	.60037

MOS 19E - Within Cells Variances and Covariances - Time and Accuracy
Fine Motor Discrete
Communication - Oral

	CL #	CO	EL	FA	GM	GT	MM	OF	SC	ST	CPAC
CL #	191.16202										
CO	138.12533	163.90781									
EL	185.72525	151.48362	208.74674								
FA	163.92285	152.35572	166.01184	176.22790							
GM	163.74452	156.63886	19[illegible].85759	145.86485	213.53943						
GT	179.37215	134.98149	174.86234	146.20598	157.62112	182.19028					
MM	113.27263	145.24309	145.24817	123.14156	165.72181	112.06255	166.24751				
OF	124.28592	140.35751	139.12080	123.08232	155.60629	125.52255	148.68601	148.80610			
SC	160.31205	161.05621	172.81890	147.17799	180.91941	163.31235	152.39827	154.76549	185.40348		
ST	182.50054	150.58647	197.30414	163.23948	193.81202	173.67443	143.95692	151.79104	180.59467	214.71018	
CPAC	91.07387	81.41279	97.72603	91.29061	93.25260	80.83585	69.86383	69.21244	78.04899	91.61685	536.36600
CPSP	28.43136	25.68347	33.28439	34.41786	22.49085	29.36857	21.02697	22.06880	23.31559	35.35842	-183.94161
PSYM	161.70246	160.41296	169.76029	180.27638	151.31086	164.79903	135.91967	141.05161	156.27543	184.00897	257.32380
SRSP	21.95327	17.85138	20.89670	27.48397	9.25714	21.42764	10.52325	14.68464	14.35480	24.55024	29.88519
SRAC	24.45210	33.23197	30.22650	24.01938	37.42200	27.52195	36.50138	35.22171	39.72431	35.20242	57.03834
SPAT	356.88335	340.98613	384.49189	373.75167	353.71562	330.46458	299.25243	290.65283	351.84199	382.54126	329.56076
FREQ4	-1.66614	-1.79765	-1.57190	-1.71399	-1.54102	-1.69541	-1.49190	-1.59493	-1.80865	-1.65090	-2.81268
REC4	1.42591	1.21260	1.65437	1.30831	1.60876	1.33003	1.17981	.99934	1.40202	1.53023	1.59522
FRE_REC4	.22436	-1.07713	.86169	-.60104	.56733	-.02217	-.76388	-1.35965	-.36417	.03699	-3.08441
TAXON4	.53074	.66248	.82785	.63706	.95220	.37929	.75311	.58067	.70542	.79568	.61214
TIME4	-1.00901	-1.49482	-1.52519	-1.19891	-1.74482	-1.09351	-1.67231	-1.43797	-1.46555	-1.30950	.08325
TAXON8A	1.27326	1.38079	1.49269	1.24508	1.58195	1.25546	1.43214	1.21791	1.55940	1.34254	.07655
TIME8A	-1.31833	-1.14046	-1.28439	-1.42664	-.98631	-1.26589	-.62922	-.89489	-1.06069	-1.54073	-.21140

	CPSP	PSYM	SRSP	SRAC	SPAT	FREQ4	REC4	FRE_REC4	TAXON4	TIME4	TAXON8A
CPSP	484.84197										
PSYM	140.51671	1216.24908									
SRSP	90.20388	150.40499	219.63431								
SRAC	7.40852	79.80849	34.32756	163.39568							
SPAT	216.94415	706.78131	107.52000	84.30688	1760.93164						
FREQ4	1.20309	-1.06571	.96605	-.27994	-4.84254	.82718					
REC4	.19454	1.79875	-.25110	.91503	4.58025	-.40887	.65072				
FRE_REC4	3.10321	-.01012	.59245	1.99981	2.20256	.69017	.60663	3.91444			

	CPSP	PSYM	SRSP	SRAC	SPAT	FREQ4	REC4	FRE_REC4	TAXON4	TIME4	TAXON8A
TAXON4	.23325	1.00687	.02208	.62029	3.17418	.07734	-.06682	.06162	.17452		
TIME4	-1.92213	-2.63254	-.25660	-.06552	-5.73087	-.08979	.05460	-.08824	-.08298	.30767	
TAXON8A	.10384	1.90857	.27809	.02562	4.16509	.07455	-.04623	-.02999	.04910	-.06241	.37554
TIME8A	-1.07633	-3.26339	-1.49898	.03238	-2.80082	-.07267	.04400	.07925	.04306	.07289	.02759

	TIME8A
TIME8A	.64743

MOS 31C - Within Cells Variances and Covariances - Time and Accuracy

Cognitive - Reasoning/Problem Solving/Decision Making

	CL #	CO	EL	FA	GM	GT	MM	OF	SC	ST	CPAC
CL #	165.25004										
CO	98.50251	124.87847									
EL	150.31461	113.67266	168.28208								
FA	134.15899	113.69662	130.83617	143.54885							
GM	120.80093	117.11880	154.86321	106.31867	169.84553						
GT	148.30433	92.17901	135.74630	112.13327	109.69337	148.38786					
MM	75.79810	109.13442	109.52056	85.50878	130.12588	71.87200	131.52660				
OF	88.52535	97.01713	100.90309	84.57235	111.63647	86.32414	105.63585	101.21787			
SC	128.54511	129.21592	142.36548	116.14400	147.95145	127.95096	126.52615	120.95472	163.39163		
ST	150.57336	112.31395	160.22946	130.72581	150.28336	137.32109	108.94963	113.56417	150.27280	178.23539	
CPAC	36,33004	25.52761	39.87018	31.90690	36.83382	32.66248	17.92150	20.92645	26.22090	39.74705	468.41568
CPSP	40.71973	40.80756	48.38224	50.77840	40.60048	32.13131	36.76548	29.91995	36.84112	44.85855	-227.40172
NMSA	167.76344	105.44590	149.33187	151.93343	102.33841	147.60294	63.84921	77.02688	106.88817	129.03567	40.16929
SRAC	29.70639	26.30044	34.06546	31.96610	27.05801	28.51723	22.01523	19.19210	27.22665	32.86518	22.77149
SRSP	19.66290	14.22803	24.87902	20.73443	19.75718	16.44072	15.23325	10.82293	13.69236	19.23319	-15.03969
SPAT	297.58010	285.77720	306.03657	324.31589	274.66613	258.21293	219.82199	221.25190	303.35449	330.58388	190.51486
RGRLVL	18.40773	11.53512	16.88140	13.91850	13.69919	18.44618	8.98088	10.75656	15.96816	17.03864	3.96040
FREQ3	-.25928	1.03643	.28742	.37654	.65351	-.08578	1.44920	.78001	.90399	.07405	1.83842
REC3	-1.22104	-1.35206	-1.44277	-1.31702	-1.35462	-1.19274	-1.35442	-1.09732	-1.46848	-1.22273	-.02308
FRE_REC3	-4.38080	-2.28201	-3.63675	-3.42032	-2.71360	-4.01947	-1.20377	-1.98619	-2.81671	-3.56252	4.72848
TAXON3	2.13591	1.55561	2.22778	1.98330	1.90577	1.81270	1.25867	1.23137	1.68014	2.05968	2.05839
TIME3	-.68601	-.87110	-.69485	-.99758	-.52396	-.54481	-.69277	-.64163	-.61509	-.55280	-.16899

	CPSP	NMSA	SRAC	SRSP	SPAT	RGRLVL	FREQ3	REC3	FRE_REC3	TAXON3	TIME3
CPSP	495.18861										
NMSA	150.02722	568.20944									
SRAC	6.94361	34.40341	214.14505								
SRSP	103.37751	70.72928	-6.20842	180.65233							
SPAT	227.16520	372.45683	53.08736	93.44333	1685.18131						
RGRLVL	4.17871	18.56694	3.61461	2.22238	32.13157	2.31099					
FREQ3	-1.90137	.11960	-1.05850	-1.50970	-2.61967	-.01646	1.28039				
REC3	-1.01212	-1.18152	1.30522	.43124	-1.22671	-.14349	-.71184	.84466			
FRE_REC3	-6.97011	-3.35254	2.22513	-2.21591	-12.31933	-.49213	.82885	.97289	6.31427		

	CPSP	NMSA	SRAC	SRSP	SPAT	RGRLVL	FREQ3	REC3	FRE_REC3	TAXON3	TIME3
TAXON3	-.07354	2.53344	.66394	.13222	5.59749	.22116	.16028	-.14819	-.06123	.28271	
TIME3	-.97909	-2.46653	.27302	-.48469	-4.92647	-.07646	-.05579	.04224	-.01386	-.01661	.35238

MOS 71L - Within Cells Variances and Covariances - Time and Accuracy
Communication - Reading/Writing

	CL *	CO	BL	FA	GM	GT	MM	OF	SC	ST	CPAC
CL *	159.27906										
CO	115.62215	155.30721									
BL	153.90041	129.48767	177.10645								
FA	134.85247	138.14987	138.22666	151.76153							
GM	139.00220	139.45175	173.75370	127.44935	192.66149						
GT	144.98569	108.84841	137.28461	116.05994	123.91493	145.85151					
MM	87.97482	125.67440	118.26228	103.66913	140.72438	78.84803	135.21418				
OF	99.20744	120.37037	111.45735	102.16574	128.99000	95.33217	116.95355	118.76063			
SC	135.77781	149.70663	147.79963	132.18578	159.30749	132.96984	130.92140	132.92192	168.11118		
ST	151.18904	132.20615	165.06362	137.82444	167.41659	137.92150	118.81347	125.91031	156.25815	178.73498	
CPAC	60.78063	60.59089	63.55875	64.10531	60.64750	55.50674	44.39350	47.48837	61.00228	66.25508	361.17274
CPSP	27.47516	48.52187	42.57489	43.77097	48.94401	20.78127	43.72172	37.11939	41.14477	43.97949	-131.08711
SRAC	29.19494	26.23658	28.14310	23.91362	29.03917	33.02787	19.19328	26.58608	30.75571	34.75682	57.04816
SRSP	.11347	15.71048	.43983	11.23040	-.00548	3.06924	2.64166	3.94643	5.68439	.26005	-3.73404
SPAT	306.33986	329.21234	328.61228	338.23569	320.66022	273.16338	262.77733	261.07986	337.53364	345.75324	266.76220
RORLVL	17.97934	13.54736	17.07269	14.44980	15.37635	18.06821	9.77372	11.78844	16.48952	17.09931	6.86623
FREQS	.01625	.11028	-.16617	.45650	-.43657	-.14920	-.34856	-.32400	-.39918	-.24974	.55479
RECS	-.34368	-.06935	-.12274	-.42825	.12579	-.16635	.24931	.05764	.10176	-.16761	-.31642
FRE_RECS	-2.10908	-1.36451	-2.07832	-.81670	-2.34272	-2.50413	-1.33754	-1.90627	-2.41688	-2.26811	.64240
TAXONS	2.55023	2.00021	2.33733	2.47725	2.00924	2.19281	1.24593	1.48469	1.98626	2.33052	2.77662
TIMES	-.25878	-.25235	.25626	-.21080	.35624	-.40725	.23174	-.19989	-.10545	.03969	-.82054

	CPSP	SRAC	SRSP	SPAT	RORLVL	FREQS	RECS	FRE_RECS	TAXONS	TIMES
CPSP	479.02324									
SRAC	-31.54784	199.34840								
SRSP	71.18250	4.21583	182.06507							
SPAT	219.48060	69.00951	53.43266	1671.01617						
RORLVL	2.61066	3.96018	.35804	33.85572	2.25531					
FREQS	.94654	.15709	.16469	1.94937	-.01399	.83188				
RECS	-.41635	-.10013	.09097	-2.67995	-.02387	-.60679	.66374			
FRE_RECS	.70595	-.01402	.46428	-4.22552	-.30060	.60403	.11095	2.54268		
TAXONS	.64212	.70189	.40864	8.84403	.27084	.14811	-.12510	.06367	.23416	
TIMES	-1.20449	-.58158	.22175	-1.64988	-.04787	-.10289	.07590	-.04126	-.04449	.56118

MOS 95B - Within Cells Variances and Covariances - Time and Accuracy
Cognitive - Numerical
Fine Motor Discrete

	CL *	CO	EL	FA	GM	GT	MM	OF	SC	ST	CPAC
CL *	88.94946										
CO	57.30364	94.98460									
EL	73.72800	60.65891	84.26511								
FA	80.33972	81.88018	71.21450	99.84914							
GM	52.56569	65.01889	74.21795	53.25113	88.15212						
GT	77.24647	54.71439	64.24970	65.92630	45.89536	78.51556					
MM	37.14640	77.91480	57.26024	55.16474	75.46014	36.05555	93.33444				
OF	42.61789	69.98678	46.65345	53.65263	59.36730	43.04882	74.25017	70.78325			
SC	57.66193	78.28907	60.69639	63.09997	67.77399	59.55668	71.99173	67.23663	81.49151		
ST	61.51069	53.44665	64.01344	60.31494	61.07758	54.59528	49.11607	49.91046	58.86446	66.77313	
CPAC	21.07260	20.29309	14.87112	26.81029	8.43748	17.87225	9.75407	11.19100	10.28241	9.14178	416.10412
CPSP	16.32702	22.83994	13.30131	39.09428	11.83312	9.20014	19.39475	21.51076	15.61036	20.20414	-171.15935
NNSA	100.50395	72.67536	77.08681	102.85196	45.61892	86.36134	52.01336	61.79405	52.13401	54.05943	27.14755
PSYM	40.45112	74.33015	47.89860	71.29028	44.24348	34.58794	74.30286	61.37648	56.25361	39.90167	121.17299
SRAC	11.94574	13.35588	12.41189	14.88022	11.17939	10.49325	13.86796	13.29315	10.17381	11.14889	35.99515
SRSP	10.41498	13.25145	7.33021	16.93802	3.49439	9.82206	7.56874	11.34845	6.78895	9.03572	-3.76334
SPAT	137.30931	174.01083	139.09558	183.14817	122.02137	118.31398	141.38111	126.70819	150.91191	128.02223	132.76218
FREQ2	.07753	.58127	.40727	.46694	.49661	-.14313	.43777	.19586	.32063	.22226	-.21827
REC2	-.51083	-.40561	-.60422	-.58579	-.42506	-.42465	-.20545	-.17028	-.41006	-.56049	.26906
FRR_REC2	-1.21756	.20654	-.32447	-.25841	.19625	-1.77150	.55628	-.20836	-.54751	-.88750	-.00437
TAXON2	1.41187	1.68387	1.54405	1.74302	1.43911	1.19642	1.42005	1.21392	1.49253	1.33159	.59495
TIME2	-.84334	-1.40198	-.73230	-1.42192	-.66817	-.70867	-1.08808	-1.13386	-1.01454	-.83360	-.75802
FREQ4	-.28729	.34571	.01227	.04317	.23040	-.37940	.10986	-.06405	.09235	-.11331	-.50182
REC4	-.49142	-.27675	-.39142	-.42365	-.33344	-.32258	-.05379	-.14765	-.24177	-.33381	.52819
FRR_REC4	-2.55526	-.56104	-1.42366	-1.53089	-.87485	-2.31164	-.17603	-.99861	-1.04680	-1.61879	.63532
TAXON4	.54454	1.04129	.80547	.87185	1.01252	.34802	1.06159	.84640	.90454	.73445	.17198
TIME4	-.22513	-.71944	-.49713	-.42977	-.71233	-.22334	-.84581	-.67811	-.69342	-.48810	.12418

	CPSP	NNSA	PSYM	SRAC	SRSP	SPAT	FREQ2	REC2	FRR_REC2	TAXON2	TIME2
CPSP	453.02147										
NNSA	164.08016	524.55943									
PSYM	156.95464	197.85183	1133.93637								
SRAC	4.74253	15.36782	24.24955	131.28098							

Within Cells Variances and Covariances MOS 95B (CONT.)

	CPSP *	WKSA	PSYM	SRAC	SRSP	SPAT	FREQ2	REC2	FRB_REC2	TAXON2	TIME2
SRSP *	79.17609	47.39801	81.79522	-3.91821	101.47392						
SPAT	212.58395	229.73998	447.24701	52.74857	59.73899	1240.70005					
FREQ2	1.27908	-.00665	3.81184	.31709	.59375	2.25146	.87337				
REC2	-1.33168	-1.13159	-3.41655	-.18271	-.24633	-1.50435	-.46005	.71202			
FRB_REC2	.52986	-3.56713	3.10309	.61902	1.27679	3.44668	1.20279	.52187	5.13212		
TAXON2	.93939	1.64467	2.23740	.31480	.15515	5.80840	.10799	-.09555	.06061	.31339	
TIME2	-1.44838	-1.53824	-3.08520	-.13893	-.84241	-4.50485	-:04165	-.00012	-.09923	-.08836	.40979
FREQ4	.82464	-.37212	2.71254	.20281	.48516	.55885	.61575	-.27948	1.04883	.06102	-.02254
REC4	-.97183	-.98010	-1.49374	-.09528	-.20499	-.76565	-.27086	.39541	.20641	-.05362	.00261
FRB_REC4	-.92876	-3.82665	2.59227	.34626	.66968	-.00714	.52550	.59667	3.23525	-.01770	-.05133
TAXON4	1.51348	1.56869	2.45891	.25160	.30001	4.73619	.11669	-.07929	.12739	.10385	-.05415
TIME4	-1.40357	-1.04296	-2.15584	.10984	-.41800	-3.27371	-.06658	.03411	-.09564	-.06332	.04664

	FREQ4	REC4	FRB_REC4	TAXON4	TIME4
FREQ4	.71151				
REC4	-.28772	.45599			
FRB_REC4	.73062	-.73829	4.32246		
TAXON4	.10029	-.06479	.01711	.23019	
TIME4	-.03978	.02100	-.03728	-.08917	.15497

‡ Variables in rows and columns use the following notation:

Variable	Label
SPAT	Overall Spatial
RGRLVL	Reading Grade Level
CPAC	Complex Perceptual Accuracy
CPSP	Complex Perceptual Speed
NMSA	Numerical Speed & Accuracy
PSYM	Psychomotor
SRAC	Simple Reaction Accuracy
SRSP	Simple Reaction Speed
CL	ASVAB Composite - CL
CO	ASVAB Composite - CO
EL	ASVAB Composite - EL
FA	ASVAB Composite - FA
GM	ASVAB Composite - GM
GT	ASVAB Composite - GT
MM	ASVAB Composite - MM
OF	ASVAB Composite - OF
SC	ASVAB Composite - SC
ST	ASVAB Composite - ST
FREQ1	Training Frequency - Visual
REC1	Training Recency - Visual
FRE_REC1	Training Frequency-Recency Interaction - Visual
TAXON1	Accuracy - Visual
FREQ2	Training Frequency - Numeric
REC2	Training Recency - Numeric
FRE_REC2	Training Frequency-Recency Interaction - Numeric
TIME2	Time - Numeric
TAXON2	Accuracy - Numeric
FREQ3	Training Frequency - Cognitive
REC3	Training Recency - Cognitive
FRE_REC3	Training Frequency-Recency Interaction - Cognitive
TIME3	Time - Cogitive
TAXON3	Accuracy - Cognitive
FREQ4	Training Frequency - F.M. Discrete
REC4	Training Recency - F.M. Discrete
FRE_REC4	Training Frequency-Recency Interaction - F.M. Discrete
TIME4	Time - F.M. Discrete
TAXON4	Accuracy - F.M. Discrete
FREQ7	Training Frequency - G.M. Light
REC7	Training Recency - G.M. Light
FRE_REC7	Training Frequency-Recency Interaction - G.M. Light
TAXON7	Accuracy - G.M. Light
FREQ8	Training Frequency - Comm. R/W
REC8	Training Recency - Comm. R/W
FRE_REC8	Training Frequency-Recency Interaction - Comm. R/W
TIME8	Time - Comm. R/W
TAXON8	Accuracy - Comm. R/W
TIME8A	Time - Comm. Oral
TAXON8A	Accuracy - Comm. Oral